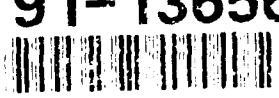
REPORT NO. T20-90

VOLUNTARY CONSUMPTION OF A LIQUID CARBOHYDRATE SUPPLEMENT BY SPECIAL OPERATIONS FORCES DURING A HIGH ALTITUDE COLD WEATHER FIELD TRAINING EXERCISE

US ARMY RESEARCH INSTITUTE OF ENVIRONMENTAL MEDICINE
Natick, Massachusetts

SEPTEMBER 1990



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USARIEM TECHNICAL REPORT No T20-90

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Human subjects participated in these studies after giving their free and informed voluntary consent. Investigators adhered to AR 70-25 and USAMRDC Regulation 70-25 on Use of Volunteers in Research.

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In conducting the research described in this report, the investigators adhered to the "Guide for the Care and Use of Laboratory Animals," as prepared by the Committee on Care and Use of Laboratory Animals of the Institute of Laboratory Animal Resources, National Research Council.

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13 ABSTRACT (Maximum 200 words)

A six day field test was conducted to measure the energy expenditures, activity levels and nutrient intakes of unsupported soldiers consuming the Ration, Lightweight (RLW) with a liquid carbohydrate (CHO) supplement during a strenuous field training exercise at high altitude.

Ten soldiers (±SD; age 32±5 yrs, wt 81.2±9.7 kg, and body fat 18.9±8.3 %) were required to consume the RLW and a liquid CHO supplement exclusively for six days. Body composition measurements (anthropometry and hydrostatic weighing), activity levels (ambulatory monitors), food and water intakes (log book technique), and ration acceptability (post study questionnaire) were recorded.

Mean caloric intake for the six day study was 2467±384 kcal/day (12% protein, 34% fat and 54% CHO). Mean energy expenditure using the intake/balance method was 4294±1276 kcal/day. Body weight loss averaged 1.7±0.7 kg with 35 percent from fat free mass and 65 percent from fat mass. Total fluid intake was 3.6 L/day. Carbohydrate intakes from the RLW and CHO supplement were 229±55 (916 kcal/day) and 103±44 g/day (412 kcal/day), respectively.

The results of this study demonstrate the feasibility and desirability of supplementing military rations used for high altitude operations with CHO. In addition, these results suggest that the RLW could be used for short-term, high altitude operations if a CHO supplement is also issued.

14 SUBJECT TERMS
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EXECUTIVE SUMMARY

A six day field test was conducted to measure the energy expenditures, activity levels and nutrient intakes of unsupported Special Operation Forces (SOF) soldiers consuming the Ration, Lightweight (RLW) with a liquid carbohydrate (CHO) supplement during a strenuous field training exercise (FTX) at high altitude (7,000 to 11,000 feet). The field study was conducted at Mt Rainier National Park, Washington State, from 19-23 March 1989.

Ten SOF soldiers (±SD; age 32±5 yrs, ht 179.5±6.7 cm, wt 81.2±9.7 kg, and body fat 18.9±8.3 %) were required to consume the RLW and a liquid CHO supplement exclusively for six consecutive days. The soldiers practiced ski-mountaineering, identification of hazardous snow conditions, small-unit and advanced movement skills, and cold weather survival techniques for 5 days. On day 6 subjects returned to Ft Lewis because of severe weather conditions but remained on the ration and beverage supplement until post-testing could be completed. Body composition measurements (anthropometry and hydrostatic weighing), activity levels (ambulatory monitors), food and water intakes (standard log book technique), and ration and supplement acceptability (post study questionnaire) were recorded.

Mean caloric intake for the six-day FTX was 2467±384 kcal/day (12% protein, 34% fat and 54% CHO). On average, subjects consumed 74 to over 100% of the Military Recommended Daily Allowances (MRDA) for all nutrients studied. Mean energy expenditure using the intake/balance method was 4294±1276 kcal/day. Body weight loss averaged 1.7±0.7 kg with 35 percent from fat free mass and 65 percent from fat mass. Total fluid intake was 3.6 L/day. Carbohydrate intakes from the RLW and beverage supplement were 229±55 (916 kcal/day) and 103±44 g/day (412 kcal/day), respectively.

The additional carbohydrate from the beverage supplement helped to restore/maintain body glycogen stores and probably reduced potential decrements in physical performance. The results of this study demonstrate the feasibility and desirability of supplementing military rations used for high altitude operations with CHO. This CHO supplement has the potential of improving soldiers' hydration status and reducing the loss of lean body mass during acute periods of caloric inadequacy.

Though the RLW was issued at the rate of 4000 kcal/man/day, the soldiers voluntarily consumed only one half that amount. Similar results at high altitude have been reported using the Meal, Ready-to-Eat (MRE). The RLW appeared no more effective than the MRE at high altitude but was considerably lighter to carry. These resultsuggest that the RLW could be used for short-term, high-altitude operations if a CHO supplement is also issued.

INTRODUCTION

Although most rations contain enough Calories and carbohydrate (CHO) to meet energy demands and maintain adequate glycogen stores, soldiers frequently do not consume enough to meet the energy and CHO demands of strenuous field training exercises (FTX). This sub-optimum ration consumption and the inevitable loss of body weight are well-documented and occur despite the type of field ration the soldiers are consuming (1-13). Inadequate food intake has been ascribed to poor ration palatability, menu boredom, inability to work on a full stomach, lack of water, decreased appetite due to increased exercise, lack of specific meal periods and time to prepare meals, anxiety due to field conditions and intentional dieting (12,14).

In animals, it is thought that anorexia, (reduced food intake even when food is readily available), may improve survival and competitive success during important activities such as defense against predators, seeking shelter from bad weather, migrating, and courtship (15-16). The universality of the voluntary anorexia seen in soldiers during field exercises suggests a similar innate process may be occurring. Although it is difficult to envision the adaptive value of anorexia to soldiers operating in a field environment, it is possible that anorexia could help soldiers adapt to some demanding situations. A decrease in the need to carry, prepare and eat rations would decrease the energetic cost of load carriage and increase the amount of time and resources available for more immediately important military tasks. In addition, a decrease in food intake might benefit the soldier by limiting post-meal impairments in the ability to maintain attention and react quickly (17).

There are, however, potentially maladaptive aspects to reduced food intake. Although soldiers normally have large reserves of body fat to buffer shortfalls in dietary energy intake (18), body CHO reserves constitute only around 2% of the body's energy reserves, and are readily depleted in the absence of adequate dietary CHO intake (19). When carbohydrate reserves are depleted there is a switch to a fat-predominant fuel metabolism characterized by decreased physical performance (20), and loss of lean body mass (2).

Soldier anorexia need not lead to a fat-predominant metabolism with its attendant problems. A growing body of scientific evidence suggests that a fat-predominant metabolism can be avoided and the physical performance of soldiers maintained or enhanced by drinking CHO containing beverages, or by eating solid CHO supplements, during physically demanding field operations (6,21-24). The purpose of this experiment was to test the effectiveness of a liquid CHO supplement in improving the nutritional status of soldiers conducting high altitude cold weather field operations.

METHODS

This investigation was a collaborative project of the 1st Special Forces Group (SFG), Ft. Lewis, WA, the Food Engineering Directorate of the Natick Research Development and Engineering Center, and the Altitude Research and Military Nutrition Divisions at the U.S. Army Research Institute of Environmental Medicine (USARIEM) in Natick, MA.

TEST SUBJECTS

Ten soldiers from B company, 2nd Bn, 1SFG(A) were briefed on the purpose of the research study and the risks and benefits involved. The FTX was scheduled training and would have been conducted with or without this study. This study was approved by the USARIEM and United States Army Materials Research Development Command/Office of The Surgeon General (USAMRDC/OTSG) Human Use Review Committees. Test subjects were given informed volunteer agreement affidavits (Appendix A) to sign and instructed that they could withdraw from the study at any time without penalty or loss of benefits.

All ten test subjects were highly trained Special Forces soldiers whose ranks ranged from E-6 to Captain. Soldiers averaged 12.1 years active military duty. Each subject passed a pre-study physical examination. The physical characteristics of the study group are listed in Table 1.

OPERATIONAL SCENARIO

The field study (RAINIEREX) was conducted at Mt Rainier National Park from 19-23 March 1989. This exercise was the capstone of the detachment's winter warfare training program, and followed almost three months of intensive training in cold weather skills. RAINIEREX was designed to train soldiers in high altitude acclimatization, ski

TABLE 1 SUBJECTS' INITIAL PHYSICAL CHARACTERISTICS

SUBJECT No.	AGE (yrs)	HEIGHT (cm)	WEIGHT (kg)	BODY FAT (%)	BODY SURFACE Area (M^2)
1	32	193.0	93.6	15.6	2.25
2	27	177.8	79.2	21.2	1.97
3	37	177.8	81.5	22.8	1.99
4	36	180.3	95.7	30.9	2.16
5	31	170.2	70.1	6.1	1.81
6	32	172.7	68.1	16.6	1.81
7	25	185.4	77.1	7.2	2.01
9	25	177.8	77.1	16.4	1.95
10	42	180.0	88.3	29.9	2.08
MEAN	**32**	**179.5**	**81.2**	**18.9**	**2.00**
SD	**5**	**6.7**	**9.7**	**8.3**	**0.15**

mountaineering, identification of hazardous snow conditions, small-unit movement using a safety rope, use of ice-axe and crampons, self rescue techniques, climb of Mt Rainier/advanced movement skills, and advanced cold weather survival skills.

Mt Rainier National Park is located in the southern Cascade Range of Washington state and covers over 300 square miles. The summit of Mt Rainier reaches 4,392 meters (14,410 feet) (Figure 1). Paradise Park, which is located on the south slope (1,650 meters, 5,400 feet), is the staging point for most alpine activities. Camp Muir, located at 3,105 meters (10,188 feet), has a small warming hut, seen in the lower left of Figure 2, which is available for climbers and is the customary base camp for most summit attempts.

The ten man climbing team departed Ft Lewis on Sunday, 19 March 1989 for the Paradise visitor's area of Mt Rainier National Park. Permission for the exercise had been obtained from the appropriate Park Service authorities. Advanced winter warfare skills to be practiced included an attempt to climb to the summit of Mt Rainier. Ski mountaineering familiarization was conducted on 19 and 20 March. An emergency bivouac on Muir Snowfield, (vicinity of Anvil Rock, elevation 2921 meters, 9584 feet) was required on the night of 20 March due to inclement weather. The weather from the evening of 20 March, until the early morning of 23 March was blizzard-like. Temperatures were approximately 3-8°C (5-15°F) and visibility was seldom better than 15 meters (50 feet). On 21 March, three soldiers, who were unable to continue in the operation, were detached from the main element to return to the Paradise visitor's area and redeploy to Ft Lewis. The main element continued up to Camp Muir (elevation 3105 meters, 10,188 feet) arriving at 1400 hours on 21 March. The detached element did not arrive at the Paradise Ranger station at the anticipated time of 1700 hours on 21 March. The main element was able to communicate by radio with the Ranger station. The main element waited at Camp Muir for the weather to clear until the morning of the 23 of March, cancelling its attempt to reach the summit of Mt Rainier. In a scheduled 0730 hours (23 March) communications check with the Ranger station, the main element was made aware of the missing element's safe return. At 1200 hours on 23 March, the main element returned to the Paradise parking lot for redeployment. See Appendix B for a detailed schedule of events.

FIGURE 1

Southern slope of Mt. Rainier

FIGURE 2

Camp Muir, 10,188 ft elevation.

RATION AND LIQUID CHO SUPPLEMENT DESCRIPTION

Table 2 shows marcronutrients, weight and volume of the Ration, Lightweight (RLW). The RLW is a lightweight, compact ration (2,000 kcal, 454 g, 606 cm^3) which was designed to subsist Special Operations Forces in surveillance and reconnaissance operations for up to 30 days without resupply. It consists of lightweight, low volume, calorie dense food items which are generally palatable and convenient to use. When issued as two rations per day, as was done in this field test, the RLW is still considerably lighter and more compact than the Meal, Ready-to-Eat (MRE) (3,600 kcal, 2.7 kg, 4,425 cm^3) which is the standard operational ration used by the Department of Defense.

Each RLW is packaged in a vacuum shrunk rectangular package inserted into a cardboard box. A separate accessory packet (249 g, 410 cm^3) containing ice tea mix, sugar, coffee, utensils, etc. was issued for the six day exercise. All ration components can be eaten dry; some can also be rehydrated. Each ration weighs less than 454 g (not including the accessory packet) and 30 are packed into a case. The RLW is essentially an energy restricted minimum CHO ration for use of up to 30 days under conditions of light physical activity.

There are six menus of dehydrated and intermediate moisture items that are fortified with vitamins and minerals, calorically dense and freeze-resistant. These include entree bars, bread crisps, dairy bars, cereal bars, beverage bars, beef jerky, and dessert bars. All ration components are available in six flavors except the beef jerky. See Appendix C for an information paper, menu description and nutrient composition table for the RLW ration.

A CHO beverage powder supplement was also supplied on a four packet per day basis (75 gm/CHO/packet; 300 kcal/packet). This dehydrated maltodextrin $(C_6H_{12}0_5)_nH_20$ product (M-500 Maltrin, Grain Processing Corporation, Muscatine, Iowa) is defined by the Food and Drug administration as a nonsweet, nutritive saccharide polymer that consists of D-glucose units. M-500 Maltrin readily dissolves in cold water

TABLE 2 MACRONUTRIENT COMPOSITION, MASS AND VOLUME OF THE RLW*

ENERGY, kcal	4219
PROTEIN, g	142
CARBOHYDRATE, g	400
FAT, g	230
SODIUM, mg	6654
TOTAL MASS, g	912
VOLUME, cm^3	1213

*Two RLW rations per man per day and one accessory packet were issued.

and can be flavored. Maltodextrin is on the generally recognized as safe (GRAS) list and is therefore considered acceptable for human consumption. The beverage powder contains 100% maltodextrin with no added minerals. When added to a full canteen of water the concentration of the test liquid was approximately 7.5% maltodextrin, weight/volume, with an osmolality of 41.7 mOsm/kg water. The normal osmolality of human blood is between 285-295 mOsm/kg water (25).

FOOD AND FLUID INTAKE

Registered dietitians individually instructed each subject on how to accurately self-record food and fluid intake data in log books. Subjects were also informed that no supplemental foods or beverages would be permitted and they would have to consume only their designated rations for the 6 day study period. Subjects were then issued pocket sized log books (approximately 15 x 20 cm) to self-record daily food and fluid intake data (Appendix C). Soldiers selected food items that they had just consumed and then circled the estimated portion size eaten (1/4, 1/2, 3/4, or 1). If they ate more than 2 of any item or less than 1/4 they were instructed to write down the amount consumed in a separate column. The total amount of water drunk was recorded in tenths of a liter. Clear polyethylene (1 L) water containers were used to facilitate accurate monitoring of water intake. Total water intake was calculated by summing the amount of water consumed from drinking and rehydrating food and beverage items and the moisture found in the ration products themselves. Metabolic water was calculated from the water formed by the oxidation of CHO (1 g CHO = 0.60 g water), protein (1 g protein = 0.41 g water) and fat (1 g fat = 1.07 g water) in foodstuffs and from changes in body energy stores (26). At the end of the study period test subjects were interviewed by the same dietitians to verify the accuracy and completeness of the recorded entries. Self-recorded food and fluid intake methods have been used in past ration tests and have produced accurate results (27).

NUTRIENT COMPOSITION

Nutrient intakes were calculated by factoring individual food items consumed against known macro- and micro-nutrient values (Appendix C). These food composition tables were provided by Natick Research Development and Engineering Center and were entered into a nutrient factor file. Data reduction was done on a Digital Equipment Corporation Vax 780 computer using a nutrient analysis system developed by USARIEM. Nutrient intakes reported for this study include Calories, protein, CHO, fat, sodium, thiamin, riboflavin, niacin, vitamin B6, iron, magnesium, zinc, calcium, phosphorus, ascorbic acid, folacin, and vitamin A. Mean nutrient intakes were compared to the Military Recommended Dietary Allowances (MRDA) found in AR 40-25 (28).

BODY COMPOSITION AND BODY WEIGHT

Height was measured in stocking feet standing on a flat surface with the top of the head held horizontal. Semi-nude body weights were measured pre- and post-experiment using a calibrated digital electronic battery powered scale accurate to ±0.05 kg (SECA Model 770). The subjects were instructed to be post-absorptive (12 hr) and normally hydrated prior to body density testing. Hydrostatic weight was determined by taking 5 to 15 measurements and then determining the average of the three heaviest measurements that were within 100 g of each other. A Chatillon autopsy scale was used. Residual lung volumes were measured using a whole body plethysmography and the method of Dubosis et al (29). Percent body fat was calculated from underwater weight using the mathematical formula reported by Siri (30).

Selected circumference measurements were taken from 5 sites: arm, nipple level; chest, nipple level; waist, 1/3 the distance between the umbilicus and the xyphoid; hip, 4 cm inferior to the superior/anterior iliac spine; and thigh, 1/3 the distance between superior border of the patella and the superior/anterior iliac spine (31). The aggregate error of all five measurements was approximately ±1%.

TOTAL ENERGY EXPENDITURE

Total energy expenditure was estimated using the intake/balance method. Dietary energy intakes were calculated from daily food consumption records while changes in body energy stores were calculated from pre- to post-experiment changes in fat free mass (FFM) and fat mass (FM). Fat free mass was assumed to be 27% protein and 73% water, and fat mass was assumed to be 100% fat. The energy equivalents used for protein and fat were 4.4 and 9.5 kcal/g, respectively (32). Mean daily energy expenditure was calculated using the following equation:

$$\text{energy expenditure} = \text{energy intake} + \Delta \text{ body energy stores}$$

RESPIRATORY EXCHANGE RATIO

Subjects had their resting gas exchange measured by indirect calorimetry before and after the field training exercise. An open circuit system consisting of a hood, Applied Electrochemistry oxygen analyzer, Beckman infra-red $C0_2$ analyzer, and a Hewlett-Packard Pneumotach was used. Awake subjects were in a semi-recumbent position for 30-40 minutes while gas exchange measurements were taken.

ACTIVITY PATTERNS

Activity monitors (Actigraph, Ambulatory Monitoring, Inc., Ardsley, N.Y.) were used to identify periods of physical activity and inactivity during the study period. A compact (6.4 x 8.9 x 1.9 cm) lightweight (90 g) microprocessor-based monitor was attached to the non-dominant wrist of each subject. These monitors did not restrict the subjects' normal range of motion nor interfere with training activities. The activity monitors recorded motor activity in 3 minute epochs for the 6 day study period. The monitors were retrieved at the end of the study and the stored activity data down-loaded via an

interface to a lap-top computer. A modified sleep/wake scoring algorithm for wrist activity was used to differentiate activity and inactivity (33).

RATION ACCEPTABILITY

At the conclusion of the six day study period, each soldier was given a final questionnaire (Appendix C). It was designed to elicit opinions of such human factors considerations as overall ration and component acceptability, portion size and satiety, use of water, and ease of preparation under conditions of the field test. After completing the questionnaire, each subject was interviewed individually to check the questionnaire for completeness of responses and to clarify any written responses.

All 10 subjects appeared to give careful consideration to answering the questionnaire. Results should, however, only be considered as preliminary evidence of the reactions of a larger, statistically sufficient number of respondents operating similar field conditions. Nine-category hedonic rating scale data are reported as the Mean ± SD. Other rating scale results are reported as the Mean only. Responses to the remaining questions are reported as actual counts or percentages, as appropriate.

STATISTICAL ANALYSIS

All results are expressed as mean ± SD. A p value of less than 0.05 was considered to be statistically significant. A paired T-test was used in the analysis of the pre- and post-experiment body weight, body fat, and respiratory exchange ratio (RER) data.

RESULTS

Ten test subjects volunteered to take part in this 6 day field exercise. Subject number eight was unable to complete post-experiment measurements of body weight, body fat percent, and resting gas exchange due to a cold weather injury of multiple etiologies. However, his food and water consumption and ration acceptance data is included in this technical report.

SUBJECT CHARACTERISTICS

The physical characteristics of the subjects are summarized in Table 1. Mean pack weights, taken at Paradise Park ranger station prior to deployment, were 31.2±5 kg and ranged from 25.9 to 40.7 kg (Table 3). Load as a percent of body weight averaged 40±4% and ranged from 29 to 47%. A mandatory packing list was issued by the detachment commander to all test subjects and is shown in Appendix D.

MACRO- AND MICRONUTRIENT INTAKES

Mean daily Calorie (kcal), protein, fat and CHO intakes are shown in Figures 3-6. Subjects were issued a total of 5200 kcal/day, 4000 kcal/day as the Ration, Lightweight (two rations, 2000 kcal each) and 1200 kcal/day as liquid CHO supplement (four packets, 75 g CHO each). Test subjects consumed 26% to 49% of the liquid CHO supplement and 45% to 64% of the rations allotted to them. They consumed 40% to 61% of the total 5200 kcal/day issued. Daily energy intakes varied day-to-day with the highest consumption recorded on day four (3155±2105 kcal) when the majority of subjects were at Camp Muir waiting to make a summit attempt. Mean daily protein intake was 72 gm/day (0.88 g/kg body weight) and ranged from 59 to 86 g/day. Subjects did not consume the MRDA for protein which is 100 g/day. The 100 g/day value is in excess of normal body maintenance requirements and is designed to ensure a high level of palatability and acceptability. They did however, exceed the NAS/NRC

TABLE 3 LOAD WEIGHT

SUBJECT No.	LOAD (kg)	LOAD AS %BODY WEIGHT
1	34.1	36
2	26.9	34
3	31.8	39
4	40.7	43
5	29.1	42
6	28.4	42
7	36.4	47
9	27.3	35
10	25.9	29
MEAN	**31.2**	**40**
SD	**5.0**	**4**

Figure 3
Total Caloric Consumption

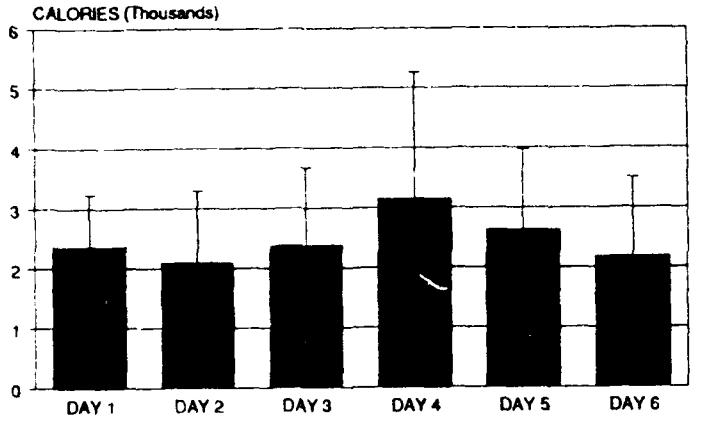


Figure 4
Total Protein Consumption

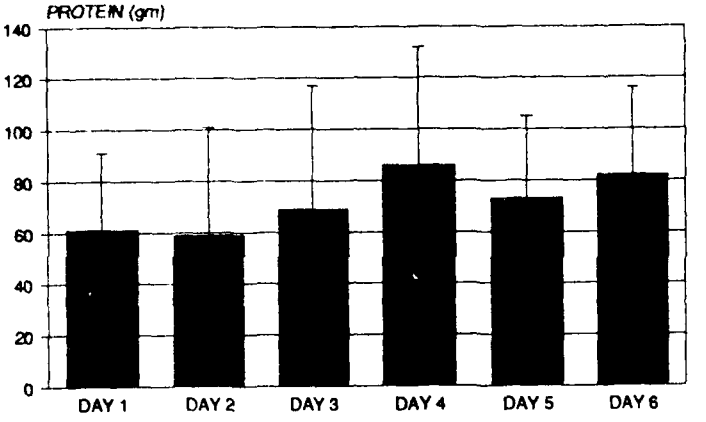


Figure 5
Total Fat Consumption

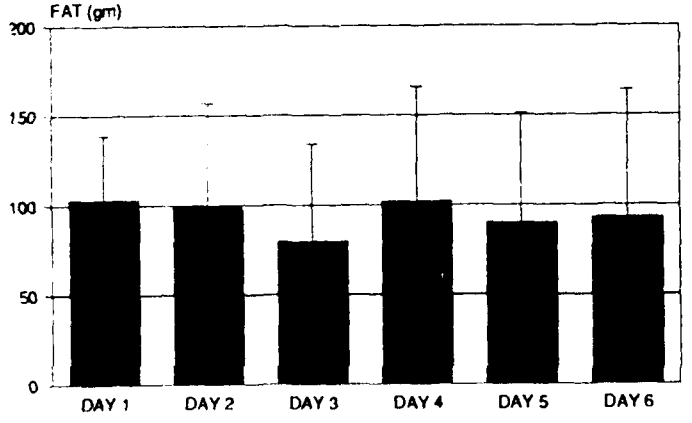
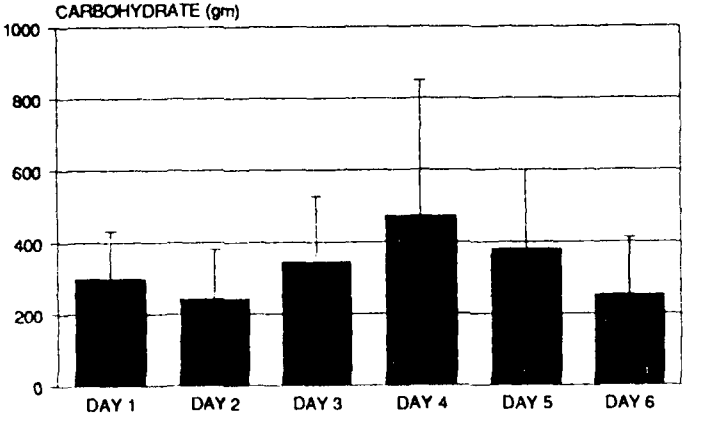


Figure 6
Total Carbohydrate Consumption



RDA of 56 g/day (34). The percent of Calories from dietary protein was 12%. Mean daily fat intakes (94±8.8 g/day) were well below the 160 g/day maximum recommended by the MRDA and accounted for 35% of dietary Calories.

Subjects were allotted a total of 700 g CHO/day. The Ration, Lightweight accounted for 400 g CHO/day while the liquid CHO supplement supplied 300 g CHO/day. Although there is no MRDA for CHO, the nutritional standards for operational and restricted rations (NSOR) does set a 440 g/day (desired content) and 100-200 g/day (minimum content) criteria for evaluation purposes. The RLW is considered a restricted ration (usually issued on a one-per-day basis) and has to meet the 100-200 g/day criteria. When issued on a two-per-day basis, as was done in this study, it just falls short of meeting the operational ration criteria. The Committee on Military Nutrition Research (Food and Nutrition Board, Commission on Life Sciences, National Academy of Sciences) recommended a ration of this type contain a minimum of 400 g of CHO/day (35). Consumption of CHO reached 472±377 g/man/day on day four of the field test. On the other five days CHO consumption ranged from 242±138 to 381±220 g/man/day. The RLW supplied 229±55 g CHO/day while the liquid CHO supplement accounted for 104±44 g CHO/day (Figure 7 and 8). Percent of Calories coming from CHO averaged 54% with, and 45% without, the liquid CHO supplement.

The overall mean daily sodium intake was 3184±456 mg/day, with daily intakes ranging from 2616±1714 to 3762±2002 mg/day (Figure 9). Sodium intake expressed as Mg Na^{++} per 1000 kcal, is shown in Figure 10. The nutritional standard for sodium recommended as safe and adequate is 5000-7000 mg/day or 1700 mg of sodium/1000 kcal (28). Subjects consumed an average of 1286 mg sodium/1000 kcal.

Mean nutrient intakes for thiamin, riboflavin, niacin, vitamin B_6, iron, magnesium, zinc, calcium, phosphorus, ascorbic acid, folacin, and vitamin A are shown in Figures 11-22 expressed as a percentage of the MRDA. Subjects consumed from 80% to well over 100% of the MRDA for all nutrients except folacin and vitamin A which had intakes in the 70% range.

Figure 7
Total Caloric Consumption

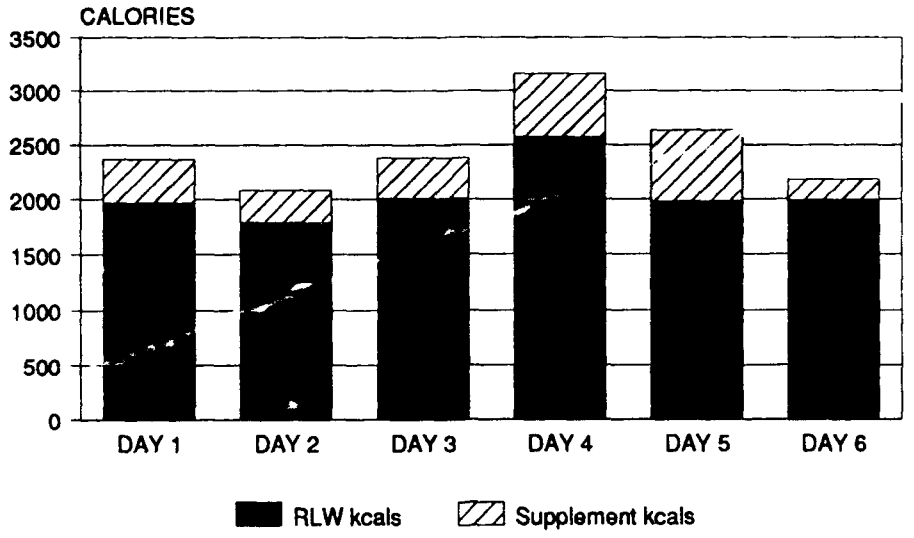


Figure 8
Total Carbohydrate Consumption

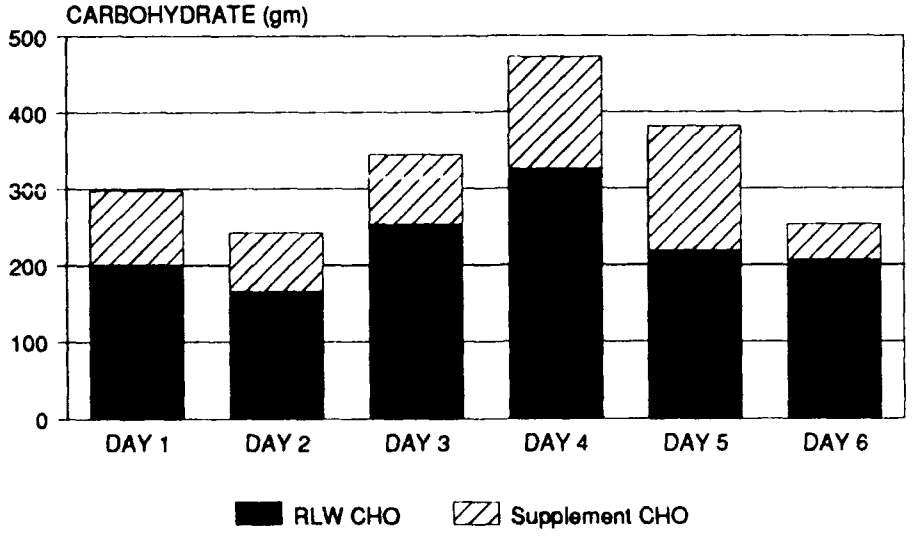


Figure 9
Total Sodium Consumption

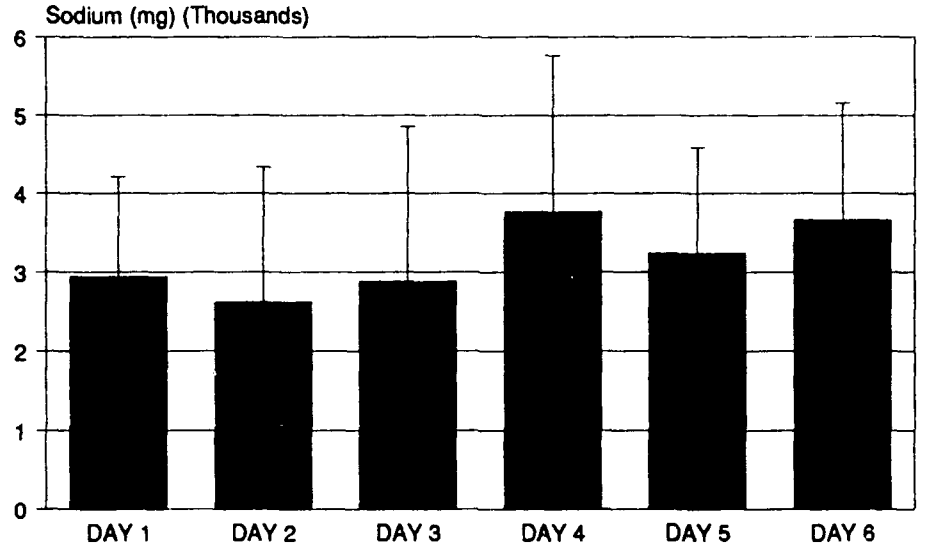


Figure 10
Sodium Intake Per 1,000 Calories

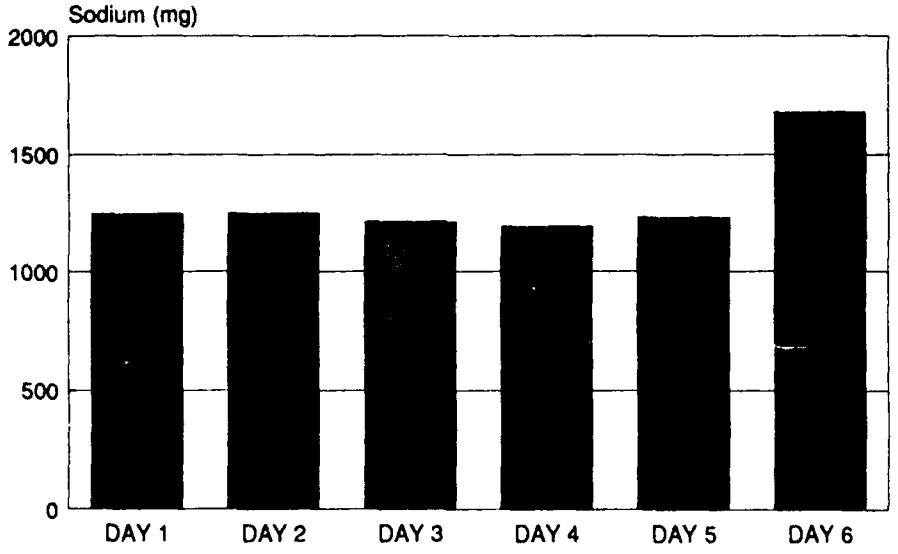


Figure 11
Mean Daily Thiamin Intake, % MRDA

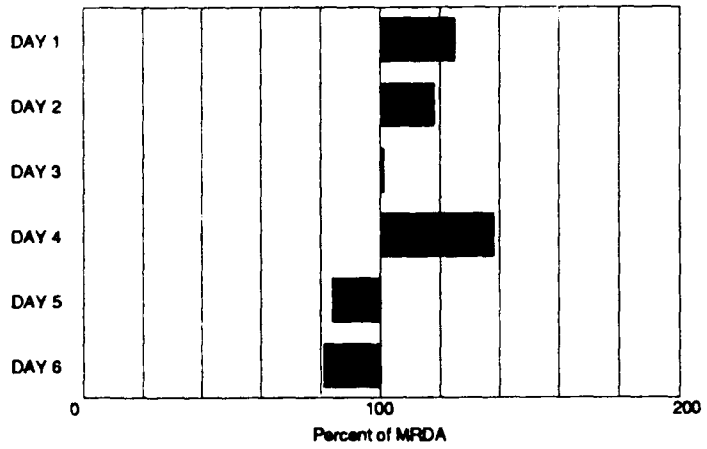


Figure 12
Mean Daily Riboflavin Intake, % MRDA

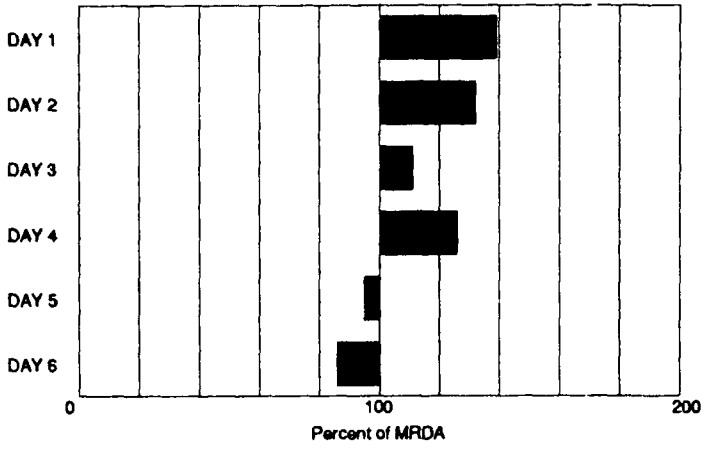


Figure 13
Mean Daily Niacin Intake, % MRDA

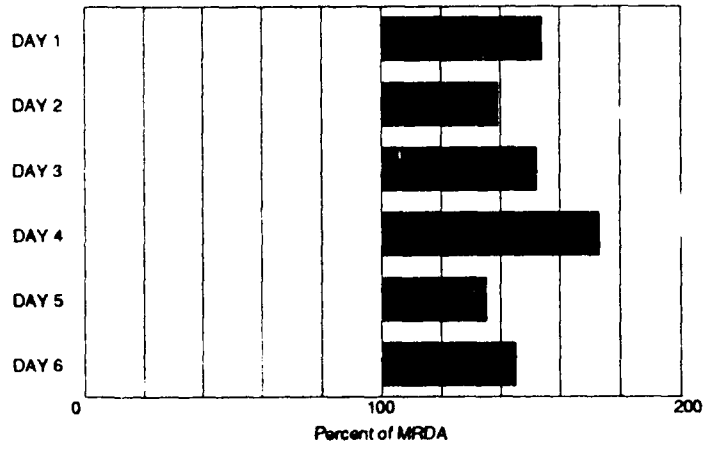


Figure 14
Mean Vitamin B6 Intake, % MRDA

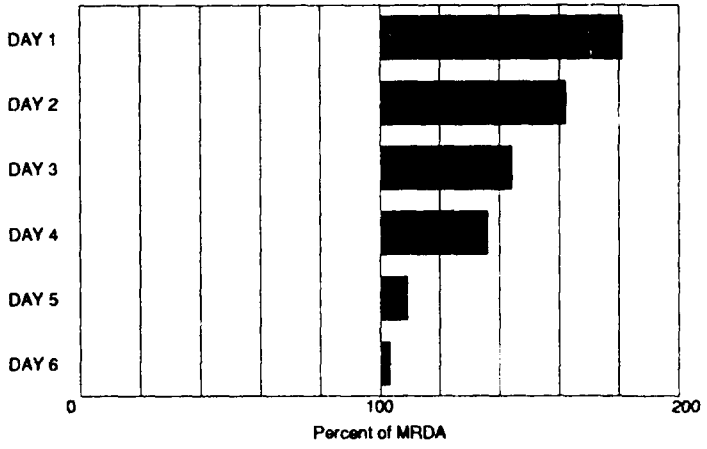


Figure 15
Mean Daily Iron Intake, % MRDA

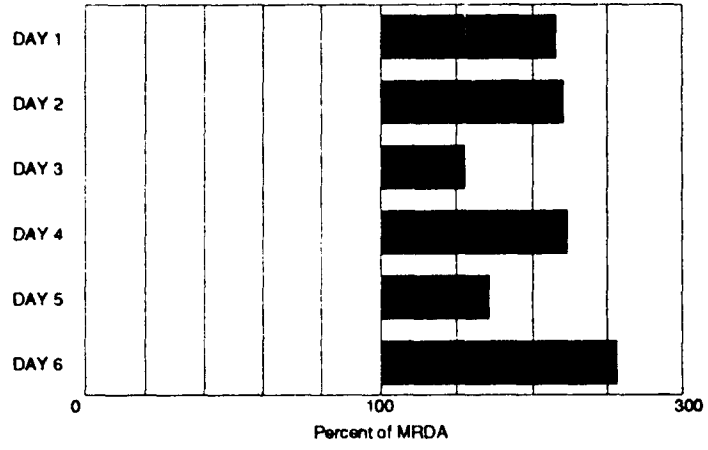


Figure 16
Mean Daily Magnesium Intake, % MRDA

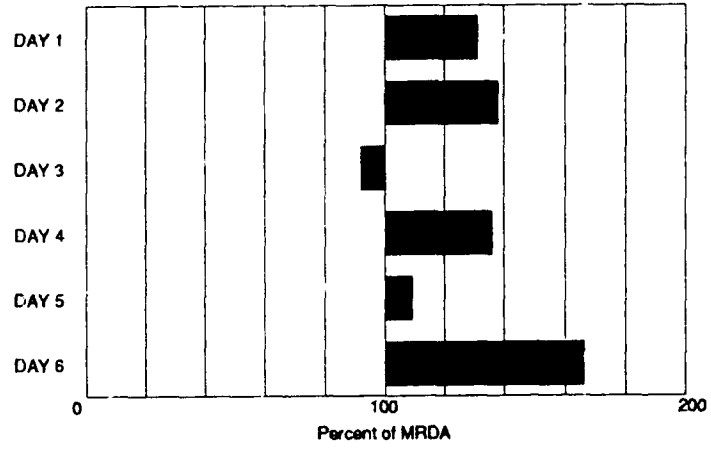


Figure 17
Mean Daily Zinc Intake, % MRDA

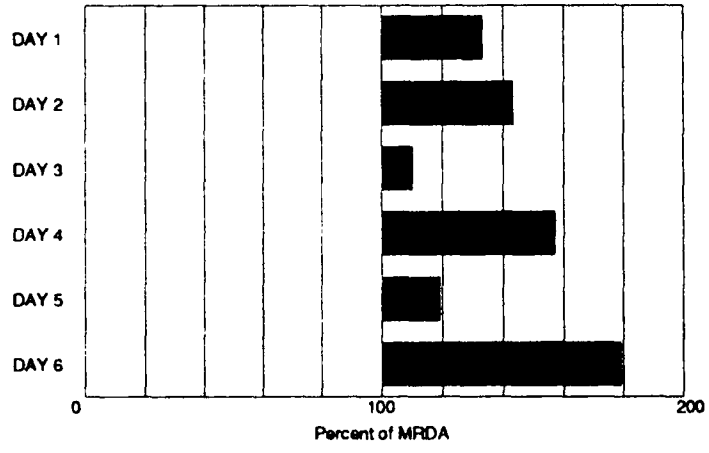


Figure 18
Mean Daily Calcium Intake, % MRDA

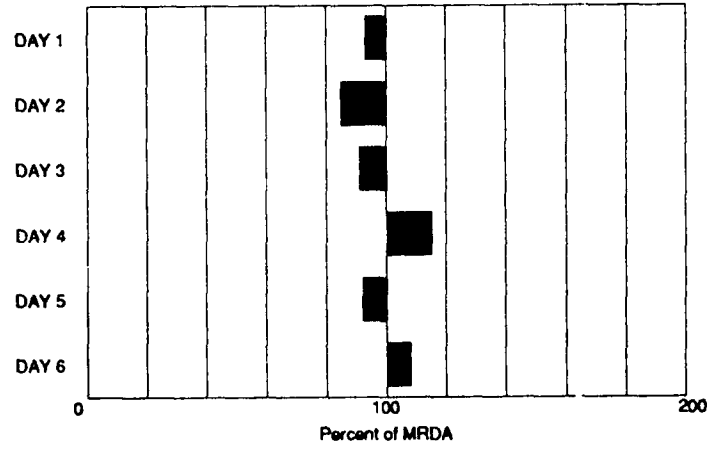


Figure 19
Mean Daily Phosphorus Intake, % MRDA

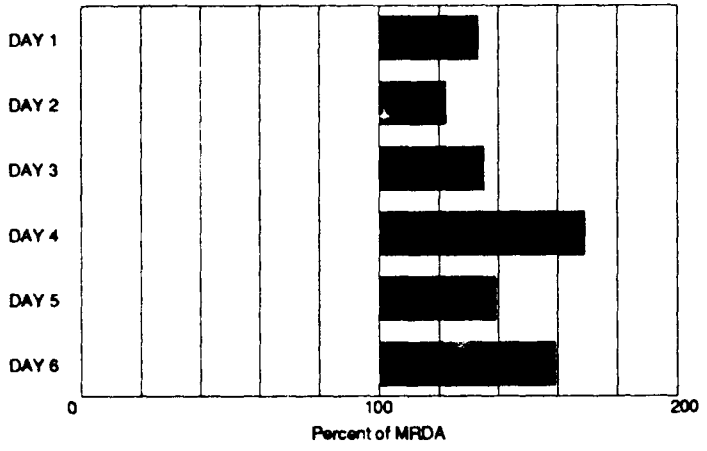


Figure 20
Mean Daily Ascorbic Acid Intake, % MRDA

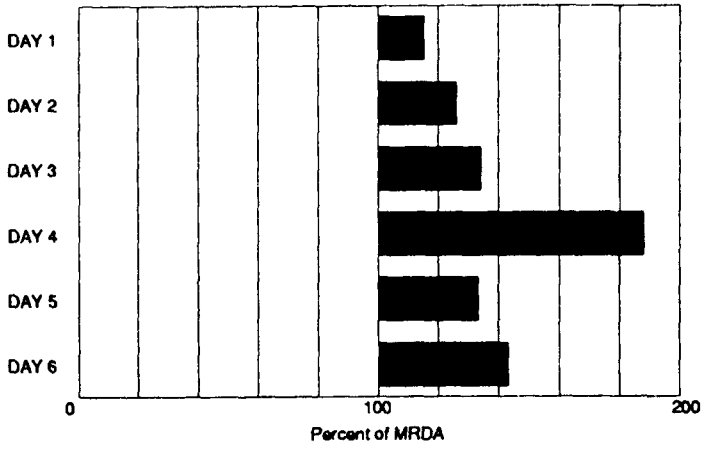


Figure 21
Mean Daily Folacin Intake, % MRDA

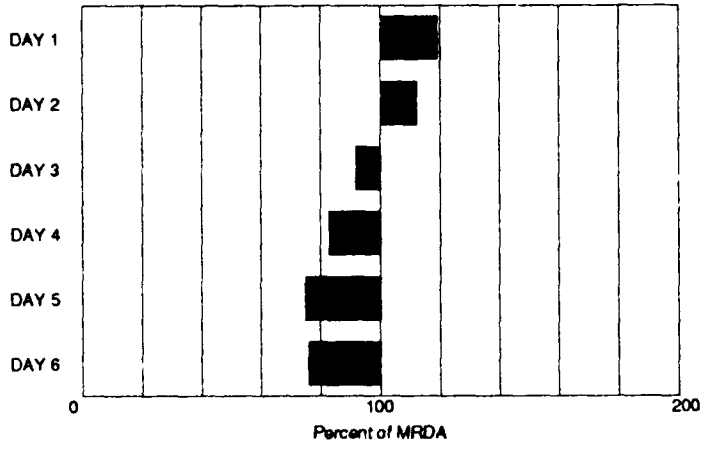
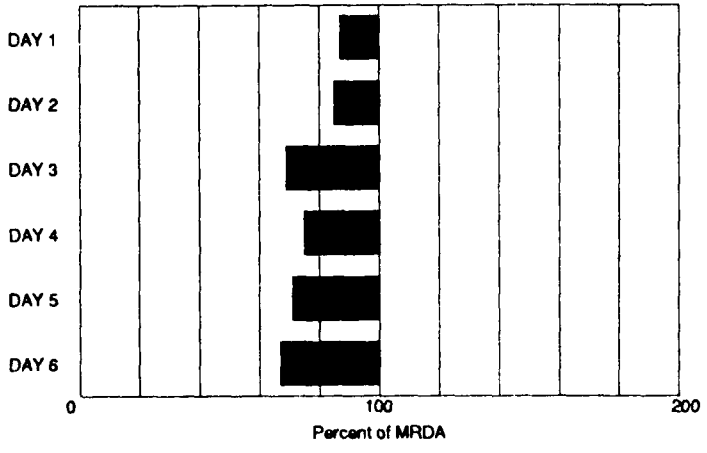


Figure 22
Mean Daily Vitamin A Intake, % MRDA



FLUID INTAKES

A comparison of water obtained from different sources is shown in Figure 23. Test subjects carried approximately 4 L into the field with them and then relied on melted snow and ice for water on days two through five. Total fluid consumed as well as water obtained from the metabolism of food and body fuel stores totaled 3.6 L/man/day (Table 4).

BODY COMPOSITION AND BODY WEIGHT CHANGES

Mean weight lost was 1.7±0.6 kg and ranged from 0.5 to 2.5 kg; fat free mass (FFM) accounted for 35% (0.6±0.7 kg) and fat mass (FM) 65% (1.1±0.9 kg) of weight lost. The decreases in body mass, fat free mass and fat mass were all statistically significant. Percent body fat change, which was not significant, can be seen in Figure 24. Mean percent body fat, as calculated from underwater weighing, decreased from 18.8% to 17.6% over the 6 day study period. Body circumference measurements showed significant decreases at the waist and hip sites, but not at the other sites measured (Table 5).

TOTAL ENERGY EXPENDITURE

Total energy expenditure was estimated by the intake/balance method (Table 6). Mean nutrient intake was 2580±999 kcal/day while body fuel reserve use (estimated from changes in body composition) was 1712±1286 kcal/day. Mean energy expenditure calculated as the sum of nutrient intake and body fuel reserve use was 4292±1276 kcal/day for the 6 day FTX.

Figure 23
Comparison of Water Sources

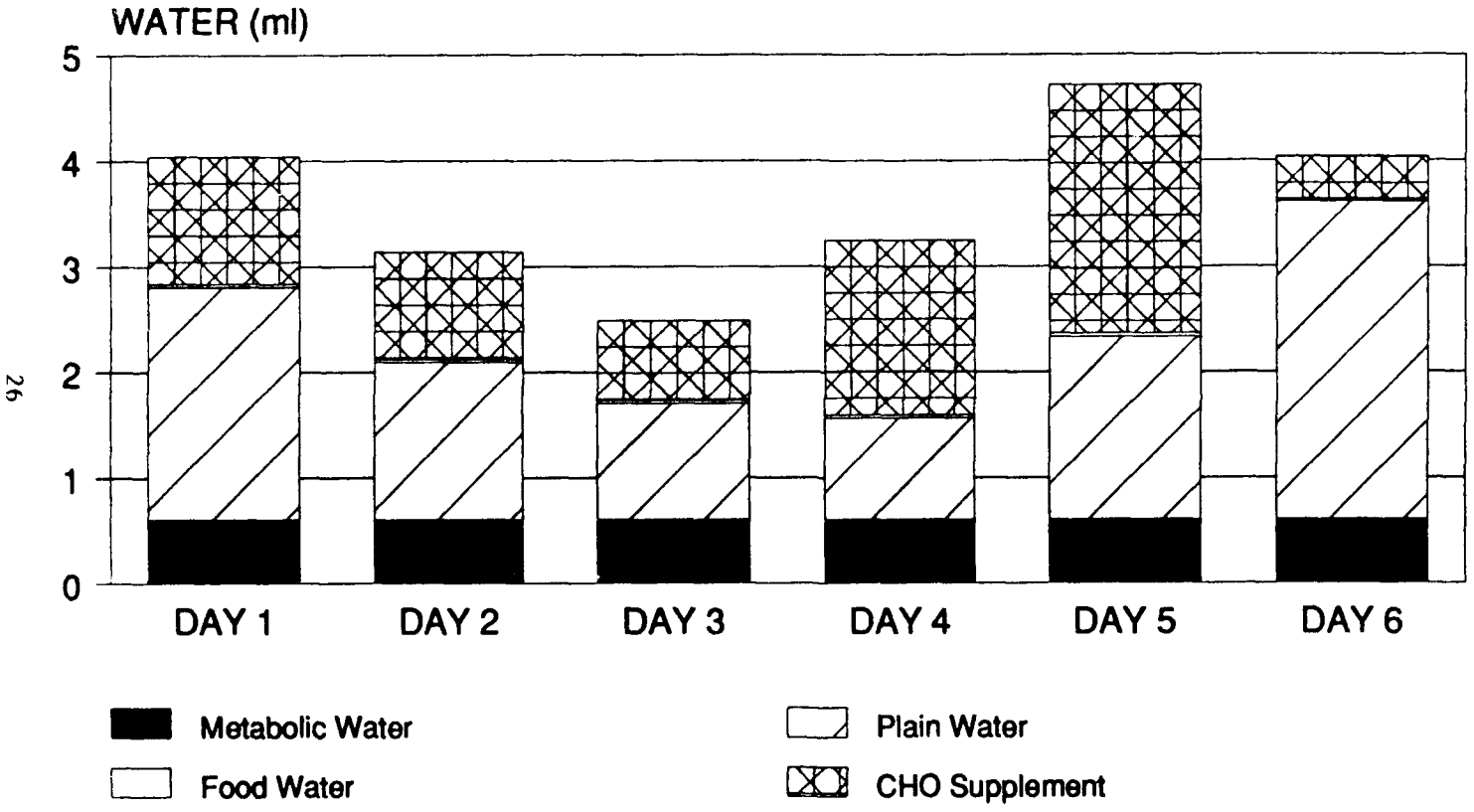


TABLE 4 COMPARISON OF WATER SOURCES (ml)

WATER CONTENT OF SOLID FOOD	30±3
LIQUID DRUNK	2973±799
METABOLIC WATER	
FOOD INTAKE	345±136
CHANGE IN ENERGY STORES	261±110
TOTAL INTAKE	**3609**

Figure 24
Body Fat Loss

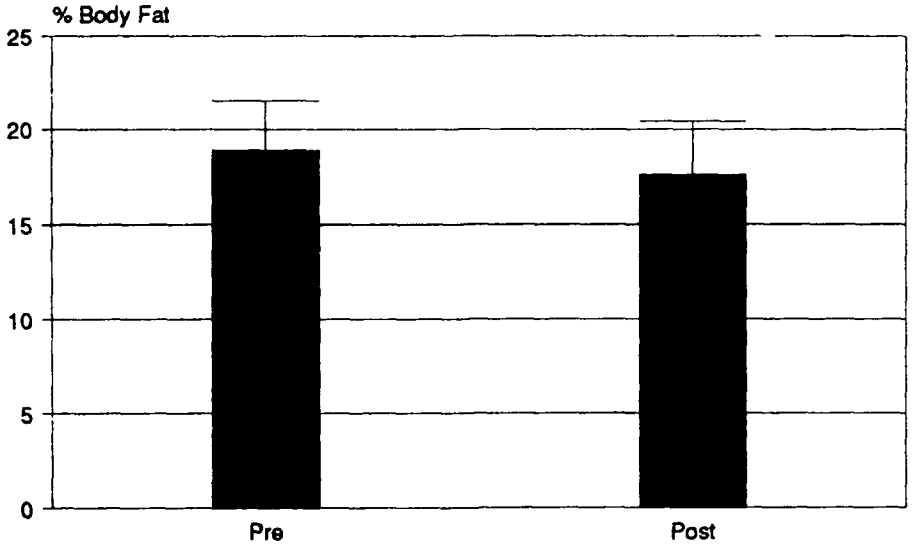


Figure 25
Respiratory Exchange Ratio

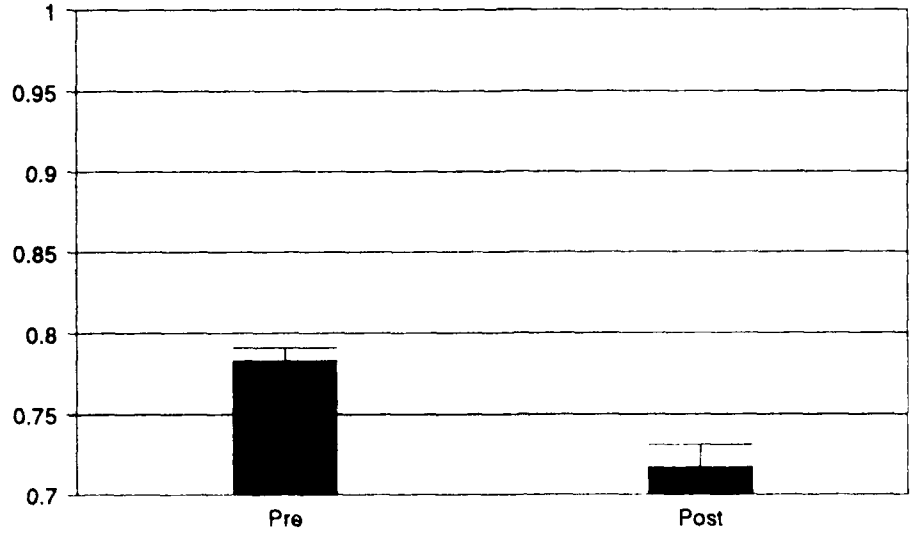


TABLE 5 CHANGES IN SELECTED CIRCUMFERENCE MEASUREMENTS DURING 6-DAY FIELD EXERCISE

CIRCUMFERENCE (cm)	PRE	POST	ABSOLUTE CHANGE	PERCENT CHANGE
ARM	33.8±1.7	33.6±1.7	-0.3	-0.6%
CHEST	101.5±7.5	101.0±7.2	-0.6	-0.5%
WAIST	86.5±8.5	84.2±9.0 *	-2.2	-2.7%
HIP	91.8±7.2	90.1±6.8 *	-1.7	-1.9%
THIGH	54.6±3.1	54.3±3.3	-0.3	-0.5%

* Significant at the P≤0.05 level

TABLE 6 ENERGY INTAKE, CHANGE IN BODY COMPOSITION AND ENERGY EXPENDITURE DURING 6-DAY FIELD EXERCISE

SUBJECT No.	INTAKE (kcal/d)	BODY WT LOSS (kg)	Δ FFM* (kg)	Δ FM† (kg)	Δ BODY STORES‡ (kcal/d)	EE§ (kcal/d)
1	3762	-2.3	-0.58	-1.67	-2759	6521
2	2564	-1.9	-0.10	-1.76	-2807	5371
3	2244	-1.8	-1.07	-0.69	-1305	3549
4	929	-2.7	-0.08	-2.58	-4101	5030
5	2167	-1.5	-1.26	-0.20	-567	2734
6	1363	-2.5	-1.68	-0.82	-1632	2995
7	3592	-1.3	-0.35	-0.91	-1510	5102
9	3450	-0.5	-0.92	+0.47	-562	4012
10	3146	-1.1	+0.45	-1.56	-171	3317
MEAN	**2580**	**-1.7**	**-0.62**	**-1.08**	**-1724**	**4292**
SD	**999**	**0.7**	**0.67**	**0.92**	**1297**	**1276**

* = change in fat free mass
† = change in fat mass
‡ = change in body stores
§ = energy expenditure

RESPIRATORY EXCHANGE RATIO

The respiratory exchange ratio (RER) is the ratio of carbon dioxide produced to oxygen consumed and was used to predict a transition from a CHO- to a fat-predominant metabolism during the five day FTX. The mean pre- and post-experiment RER values were 0.783±0.025 and 0.717±0.042, respectively (Figure 25). This decrease in the RER was significant at the $P \leq 0.05$ level.

ACTIVITY PATTERNS

Due to mechanical failure, activity monitor data were lost on two subjects who were in the 3 man element that detached and climbed down to the Paradise Ranger Station. It is reasonable to assume that the activity patterns of this one remaining test subject of these three are representative of the three man group because they were performing approximately the same tasks. This is evident when comparing the first two days of Figures 26 and 27. Notice before the 3 man element detached from the main group that their activity patterns were very similar. Hours of sleep for the 3 man element from 0600 to 0600 hours averaged 4.2 hours for the 5 day FTX. Hours of sleep for the 7 man element that climbed to Camp Muir averaged slightly over 8 hours per day for the five day FTX. The three man element's activity period (non-sleep hours) was approximately 20 h/day while the 7 man element's was approximately 15 h/day. Mean energy expenditure (as calculated from the intake/balance method) was 126 kcal/h for the three man element and 242 kcal/h for the seven man element. This was 30% and 57%, respectively, of the estimated hourly maximum sustained exercise intensity of 425 kcal/h in soldiers engaged in realistic combat activities (36).

RATION ACCEPTABILITY

The tabulation or responses to the post-test questionnaire is presented in two parts in Appendix F: Table 1, Responses to Noncategory Scale, Multiple Choice and Other Questions; and Table 2, Responses to Category Rating Scale Questions.

Figure 26
Hours Sleep 3 Man Element

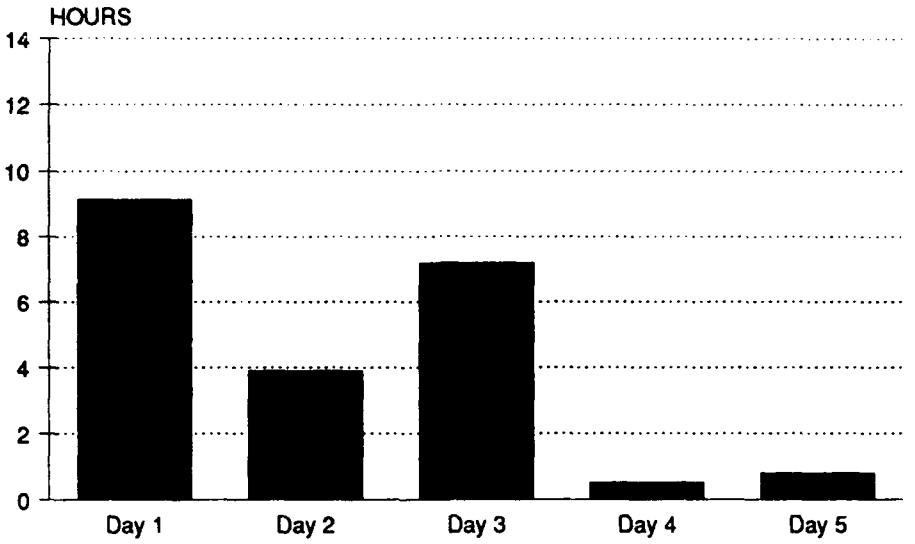
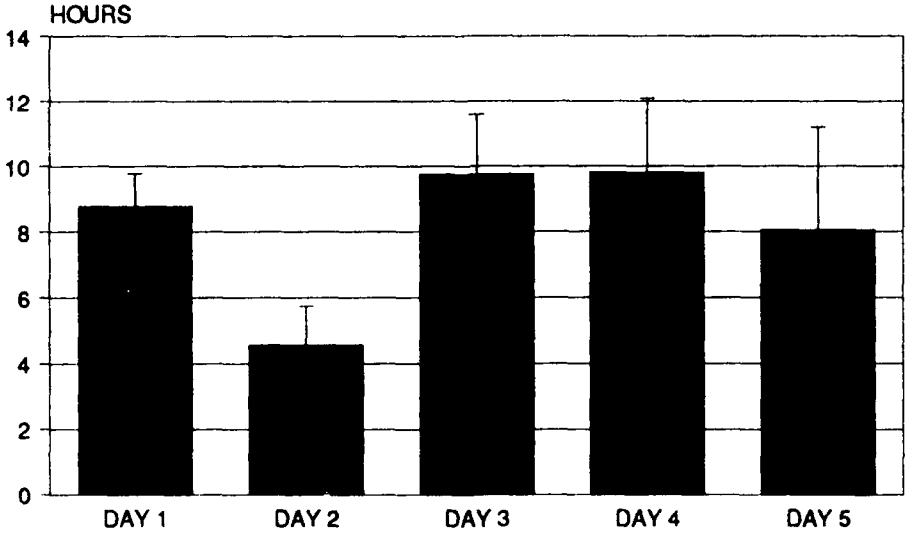


Figure 27
Hours Sleep 7 Man Element



NONCATEGORY SCALE, MULTIPLE CHOICE AND OTHER QUESTIONS

As indicated in Appendix F, Table 1, the 10-member Mt Rainier cold weather exercise test subject group averaged 12.1 years time in service and 31.5 years of age. It was composed of eight senior NCOs and two officers. Six of the group indicated that they had previous field experience subsisting on only operational rations for widely varying numbers of times. Six of the group indicated that they had previous field experience subsisting on only operational rations for widely varying numbers of times. Responses to the length of exercise part of the question were also highly variable. All but one subject described the weather during the exercise as moderately or extremely cold which was corroborated by measured temperature ranges.

Observations on eating and drinking behavior are summarized as follows: Generally, eating took place when it was possible to do so. No one reported eating all the RLW ration issued each day. Of the fruit flavored beverages, the lemonade flavor was mentioned least frequently as not being consumed at all. The numbers of "not at all" responses agreed closely with the numbers of "never tried" response, this agreed with the numbers in Appendix F, Table 2. It is not known whether this was due to nonconsumption, nonissue or both factors, since there were a relatively large number of choices. The majority consumed water with the added CHO, at meals and between meals. Except for tea and lemonade, there was a low consumption frequency of flavored beverages at mealtimes. Coffee was the least consumed beverage. A simple majority said they had enough to eat, however, eight out of the ten said they were sometimes or always thirsty. In a majority of cases, eating and drinking occurred with one or more other people.

Responses to additional questions on water were as follows: Of the reasons for not eating enough during the exercise, insufficient preparation time, insufficient water and the cold weather were cited most frequently. In the related question on water consumption, the time required and the trouble of melting snow were the most frequent reasons. As to the ability to obtain enough water for food preparation, a simple majority thought they could do so often or more frequently. Eight out of ten thought they could get enough water to satisfy thirst often or always. The differences in response patterns between this question and item 3 above suggested that subjects allocated water first to satisfying thirst then to rehydrating food. The preceding was

apparently confirmed by their report that, on average, they drank three times more water than they used in food preparation (Question 24). The group was about evenly distributed regarding the perceived ease or difficulty of obtaining water. During the exercise, the sole method of obtaining water used by most was melting snow, and the reported number of times snow had to be melted to obtain water was highly variable across the test group. Snow was typically melted by two or more persons working together, and melting was usually by choice, not by command. By and large, subjects succeeded in keeping water from freezing in their canteens during the exercise as suggested by the reported number of times water froze in their canteens. Frequency of adding a beverage powder to water was highly variable. Finally, water was heated by means of personal stoves to prepare foods and beverages.

Responses to other questions about RLW preparation were: The instructions provided were considered helpful to varying degrees. Perceived temperatures at which foods and beverages were consumed approximated those traditional to the item or class of items, i.e., entrees and "hot" beverages were warm to some degree and fruit flavored beverages and water were cool. A hand covering was typically worn while preparing and eating the RLW and subjects experienced varying degrees of cold hands during those times.

RESPONSES TO CATEGORY RATING SCALE QUESTIONS

Data presented in Appendix F, Table 2 should be interpreted with the caveat that the numbers of responses are insufficient to constitute a statistically valid sampling of a consumer population. Results may be useful, however, as general guidance for product development technologists and nutritionists.

Results of the question 5 acceptability ratings were as follows: Entrees - least acceptable items (Like Slightly on the nine-category hedonic scale) were chicken ala king and spaghetti w/meat sauce (Ratings for the latter were highly variable). Bread Crisps - three of the items approached "like slightly": (5.5 +); one, the bacon flavored version was "neutral"; and two, the coconut and orange-nut versions, were clearly unacceptable and were mentioned in question 17 as items to drop from the ration. Dessert Bars - on average, all items of this group were moderately to highly acceptable (Like Moderately to Like Very Much, 6.6 +). Dairy Bars - all items except

the orange-pineapple-coconut version were acceptable to some degree (Like Slightly, on average). The flavor version mentioned should be considered for deletion. Cereal Bars - all six types were acceptable in the "Like Moderately" range. Beverage Bars - all items were acceptable (Like Slightly to Like Moderately range). Although relatively few consumed them, the tropical punch flavor was best liked. Accessory Items - all four items in this group were highly acceptable, averaging "Like Very Much: or greater. Particularly well-received were beef jerky and hot tea.

Hedonic ratings for the RLW at the three mealtimes (question 6) indicated they were liked slightly or greater at lunch and supper meals but were regarded as "neutral" (neither like nor dislike) for breakfast. The latter rating may be due in part to the absence of items in the rating traditionally regarded as breakfast entrees. With the possible exception of item appearance, subjects were satisfied slightly to moderately with ease of preparation and heating, taste, quantity and variety (question 14). Even though all subjects indicated in question 8 that they did not eat all of the RLW meals received each day, entree bars were slightly to somewhat too small in amount of food provided. Two other groups, breakfast foods and beef jerky were in the "just right" range. Responses to this question also ran somewhat counter to the finding in question 10 that at least a majority of subjects claimed they generally had enough to eat.

DISCUSSION

This study demonstrates that a CHO beverage supplement can help soldiers improve their CHO intake during field operations. Carbohydrate intake was significantly greater in this study as compared to other RLW studies (1-2); 29% of CHO intake was derived from the beverage supplement. Easily-consumed CHO beverages (6), or highly-palatable ration supplement packs (8,37), are needed to boost CHO intake to the estimated 400 grams/man/day minimum required to maintain soldier glycogen stores and physical performance capacities (35). With only one exception (3), carbohydrate intakes by soldiers in the field have never attained the 400 g/man/day minimum suggested by the Committee on Military Nutrition Research (Food and Nutrition Board, Commission on Life Sciences, National Academy of Sciences) (35).

As with past field studies test subjects consumed inadequate Calories to meet the high energy demands of this field exercise. This is reflected in the significant amount of body weight lost (2.0%) over the 6 day study period. Of the 1.6 kg body weight lost, 35% was derived from fat free mass and 65% from fat mass. On average, subjects expended approximately 1900 kcal/day to meet basal energy needs and 2400 kcal/day during daily activities, for a total energy expenditure of 4300 kcal/day. Since caloric intake was about 2600 kcal/day subjects were consuming 60% of their caloric needs.

Although the energy intakes of this study were lower than recommended, they were comparable to other field studies of this type (1-11). The data contained in Table 7 suggests that there is an intake ceiling equal to approximately 3000 kcal per day with food wastage (ration Calories consumed/ration calories issued x 100) averaging about 32%. It appears that soldiers consume approximately 68% of their needs with weight loss being an inevitable consequence regardless of what packaged field ration is offered. Even when three different rations were issued (RLW/MRE/RCW) food intakes were similar (3). The only instance in which soldiers have maintained body weight while in the field was when they were provided hot A-rations at regularly scheduled meal times (14).

TABLE 7 MACRONUTRIENT INTAKES AND ESTIMATED ENERGY EXPENDITURE (EE) OF RECENT RATION TESTS

REF	RATION	SUB. No.	DAYS	EE (kcal)	WT. LOSS (kg)	AVAIL. KCAL	INTAKE KCAL	INTAKE %	PRO	FAT	CHO
1	RLW	36	12	3150	-2.5	2000	1780	89	55	80	210
2	RLW	17	30	3275	-5.2	2000	1945	97	64	100	197
3	RLW	10	11	4500	-2.8	4220	3205	76	109	155	345
4	MRE III	15	12	3820	-2.8	ADLIB	2285	-	100	100	250
5	MRE VI	126	11	3535	-1.7	3670	2515	69	95	120	270
5	MRE VII	129	11	3950	-2.4	4015	2515	63	105	105	290
5	MRE VIII	117	11	4150	-2.2	3940	2840	72	105	105	375
2	MRE VI	17	30	3250	-1.8	3600	2782	77	112	119	318
6	MRE III	10	6	2000	0	ADLIB	1790	-	75	82	190
6	MRE III	8	6	3250	-1.0	ADLIB	2150	-	89	97	234
7	MRE III	16	10	3950	-3.0	4892	2733	56	99	130	302
3	MRE VIII	8	11	4500	-2.1	5200	3217	62	133	136	369
8	MRE VI	32	10	3460	-2.2	4816	2009	45	82	90	210
8	MRE VIII	31	10	3855	-1.6	4571	2802	62	116	120	325
9	MRE III	27	34	2905	-3.7	3600	2189	61	81	87	246
10	MRE VI	167	3	3030	-	3670	2445	67	98	114	254
7	RCW	18	10	3950	-2.6	4541	2751	61	83	100	384
3	RCW	10	11	4500	-2.3	4470	2892	64	95	97	410
11	RCW	30	8	4700	-2.8	4470	2880	64	93	109	385
MEAN				**3670**	**-2.4**		**2512**		**94**	**107**	**293**
SD				**678**	**1.1**		**444**		**18**	**19**	**71**

*RLW, Ration Lightweight; MRE, Meal Ready to Eat; RCW, Ration Cold Weather; No., number of subjects in test; Pro, protein

Soldiers normally, perhaps innately, do not consume enough food to meet the nutrient demands of strenuous FTX. Fortunately, most soldiers have substantial body fat stores to draw upon when food intake falls short of energy expenditure, and variations in dietary fat intake have little short-term influence on the physiology or physical performance of the soldier. Anorexia may help soldiers adapt to demanding field operations by decreasing the time and energy spent preparing and consuming food, and by limiting post-meal impairments in the ability to maintain attention and react quickly (17). However, inadequate ration intake can have a negative impact on soldier performance, particularly if water or CHO balance is compromised.

WATER BALANCE

In the past it was thought that a soldier could adapt to hypohydration (13). However, it is now known that even a water loss as low as 2% of body weight (BW) can affect a soldiers physical performance and recovery (38-41). It is recommended that soldiers drink approximately 4 L water/day for normal urinary and bowel excretion in most cold weather situations (11). Reports do, however, recommend fluid intakes of up to 7 L/day at altitudes between 5,000 and 7,000 meters (42). Soldiers in this field study had variable intakes but drank on average 3.0 L/man/day.

The combustion of food and body energy stores resulted in an additional water production of 0.5 L/man/day. There was little fluid obtained from the RLW since it is a completely dehydrated ration. The water produced by oxidation from an ordinary mixed diet is about 125 g per 1,000 kcal expended (38). Since the subject's diets were high in fat due to body fat use, metabolic water was about 130 g per 1,000 kcal expended. Although fat liberates about twice as much water when oxidized as CHO or protein, more oxygen is required to oxidize fat so ventilation rate rises increasing respiratory water loss (40).

Combining fluid with food can be a practical solution to the problems of dehydration and CHO depletion in the field. As with food intake, voluntary fluid intake is often dependent on drink palatability. It has been shown that soldiers prefer a cold, flavored

rehydrating beverage over plain water (43). Although the composition of the optimum liquid CHO supplement is yet to be determined for soldiers operating under both psychological and environmental stress, general guidelines have been set by the Committee on Military Nutrition Research (Food and Nutrition Board, Institute of Medicine, National Academy of Sciences). The liquid supplement should "maximize fluid intake, replace electrolyte losses and provide a carbohydrate source for energy and rapid repletion of muscle and liver glycogen stores" (24). The liquid CHO supplement utilized in this study apparently maximized fluid intake under these circumstances and provided significantly more CHO for repletion of muscle and liver glycogen stores. Electrolyte losses under the conditions of this study were met by food nutrient intakes.

CARBOHYDRATE BALANCE

The ability of soldiers to respond to the metabolic demands of exercise can be maintained or enhanced by the consumption of a higher carbohydrate diet (44). The average soldier has limited glycogen stores which equal to only 1800 kcal or one-fiftieth that of body fat stores. Table 8 lists how long body fuel reserves would last in minutes during typical military operations. These values correspond to a caloric expenditure of 425 kcal per hour (36). It is apparent that CHO depletion is likely during strenuous FTX without adequate dietary CHO intake (45). If CHO stores are depleted and fat becomes the primary metabolic fuel, there can be as much as a 50% reduction in endurance exercise capacity and exercise intensities greater than 55% of maximum aerobic capacity cannot be sustained (44).

It has been estimated that 60 to 200 g of CHO is the minimum amount of CHO needed to maintain body function. This however, is not enough to restore muscle glycogen levels after engaging in moderate to heavy physical activity (38). The Committee on Military Nutrition Research (Food and Nutrition Board, Commission on Life Sciences, National Academy of Sciences) suggests that a minimum of 400 g of CHO per day should be supplied in rations to allow for a "reasonable" rate of glycogen resynthesis to occur (35). When a lightweight ration is required they state that special consideration should be given to CHO and if necessary calories should be reduced to allow for more CHO. Data from previous field studies does suggest that soldiers

TABLE 8 FUEL STORES IN THE AVERAGE SOLDIER

	FUEL RESERVES		HOW LONG RESERVES LAST PER MINUTE
	GRAM	KCAL	MILITARY OPERATIONS*
Adipose Tissue Triglycerides	9000	69308	11571
Liver Glycogen	100	398	57
Muscle Glycogen	350	1392	199
Blood Glucose	3	12	1.7

Adapted from Hoew RA, Young VR, Evans WJ. in: White PL, Mondeika T, ed., Diet and Exercise: Synergism in Health Maintenance, Chicago: American Medical Association, 1982.

*Assumed average energy expenditure of 425 kcal/min. Hughes & Goldman. Energy cost of "hard work." J. Appl. Phys. 29-570, 1970.

typically lack about 100 g/day/CHO in their diet to meet this minimum (Table 7). In another field test where a solid supplement was used soldiers consumed approximately 100 extra grams of CHO/day (8,37). During this field exercise subjects also consumed on average 100 grams of extra CHO from the beverage supplement. In spite of this additional CHO consumption, CHO intake was below the recommended level and there was definite evidence of a transition from a carbohydrate- to a fat-predominant metabolism (Figure 25).

PROTEIN BALANCE

Hypocaloric diets, particularly when they are deficient in carbohydrates, can readily lead to a negative nitrogen balance (46-48) and an increase the contribution of body protein oxidation to total caloric expenditure (48). The amount of protein required to cover this increase has been estimated at 1.0 to 1.2 g/kg/day (49). Inadequate carbohydrate intake can also lead to a negative nitrogen balance and a loss of lean body mass as amino acids are diverted to gluconeogenesis (50). However, nitrogen balance is less negative when the energy deficit is generated by physical activity rather than caloric restriction (51), and short term negative nitrogen balance is well tolerated and of little physiological significance in healthy young adults (52).

A limited but adequate protein intake minimizes the amount of protein used as fuel and decreases the amount of water a soldier must drink to dispose of nitrogenous waste (53). One gram of protein requires approximately 7 to 9 ml of water to be metabolized. To metabolize 150 g instead of 100 g of protein, 400 ml (about 13 oz) of extra water would be required. Since maintaining water balance is sometimes difficult in a cold environment, sparing water by consuming less protein may be important.

In this study, the protein intakes averaged 0.9 g/kg body weight, 72 g/day, or 12% of total Calories. In comparison, the MRDA for protein, which is designed to ensure a high level of palatability and acceptability, is 1.4 g/kg body weight, or approximately 100 g protein/day, or 13% of total Calories (28). The NAS/NRC RDA is 0.8 g/kg body weight, 56 g protein/day, or about 8% of total calories, and is intended to provide a "margin of safety" for persons engaged in moderate to heavy physical exertion (34). As reported by the Continuing Survey of Food Intakes by Individuals (CSFII) the mean

percent of Calories coming from protein for men ages 20-39 years is 101 g protein/day, or 15.5% of total calories (54). The subjects in this experiment exceeded NAS/NRC RDA, and probably would have exceeded the MRDA had they consumed the ration to meet caloric adequacy. The loss of FFM observed in this study was probably more closely related to a caloric and CHO deficit than to a protein deficit.

FAT BALANCE

Fat, which supplies approximately 9 kcal/g, is the most compact source of energy and is often used to increase the caloric density of combat rations. Subjects consumed an average of 94 g of fat which accounted for 35% of total Calories. Without the extra CHO supplement the percent of Calories coming from fat would have averaged 46%. Normally, the military recommends that the Calories derived from total dietary fat should not exceed 35%. As reported by the Continuing Survey of Food Intakes by Individuals (CSFII) the mean percent of Calories coming from fat for men ages 20-39 years is 36% (54).

A surfeit or deficit in dietary fat intake relative to fat combustion has little direct or immediate influence on the physioloical function or physical performance of the soldier. Only 15 to 25 g of fat are necessary to meet essential fatty acid requirements (55). Short-term fat requirements are normally met from large body fat energy reserves that have no immediate metabolic function, but serve solely as readily-mobilized energy reserves available to meet any shortfall in food energy intake (56). While negative energy balance can lead to starvation over the long term, fat energy deficits during short term military operations are of less concern. This contrasts with the more serious consequences that water and CHO imbalances can have during short term field operations. The inclusion of fat in combat rations beyond that needed to improve palatability, and perhaps satiety, may be counter productive in that it reduces the mass and/or volume available in the ration for carbohydrates, protein, or other nutritional supplements needed to maintain optimal physical performance.

The majority of soldiers have substantial body fat available to meet increased energy expenditures (Table 8). For example, a typical young male soldier weighing 74 kg (163 lb) has approximately 13.5 kg (29.6 lbs) of body fat (18). This is equivalent to 69,300 kcal, assuming a body fat energy density of 7700 kcal/kg (3500 kcal/lb) and that two-thirds or 9 kg (19.8 lbs) of this body fat can be used without encroaching on nerve sheath lipids or other fats necessary for normal physiological function. This fat reserve, which constitutes approximately 98% of the body's energy reserve (19), is enough energy to meet a 2000 kcal/day energy deficit for over a month. The soldiers in this study weighed 81.2 kg with a 15.3 kg body fat content. This is equal to 79,310 kcal, assuming 10.3 kg is body fat reserves. Approximately 11% of this fat reserve was used during the 6 days of this study. This suggests that during prolonged, physically demanding field operations, soldiers with adequate body fat stores would have an advantage over unusually lean soldiers.

MICRONUTRIENT INTAKE AND REQUIREMENTS

Most packaged rations are fortified with vitamins and minerals; however, the vitamin and mineral content of ration components are often unevenly distributed among food components since some foods are better carriers for these nutrients than others. For example, one ration component might contain half of the calcium or vitamin C of the entire ration. To assure sufficient consumption of these nutrients it is necessary to consume a variety of ration components. Since the RLW is a highly fortified ration, subjects consumed 74% to over 100% of the MRDA for all the micronutrients studied.

The majority of CHO supplements on the market are high in energy but are almost devoid of vitamins and protein. Most do have some minerals added, usually sodium and potassium. The use of these micronutrient and protein deficient beverages can be a problem if they are routinely substituted for more nutritionally balanced foods or beverages, hence lowering the overall ration Nutrient Density Index (NDI). A nutrient density index is provided by the Army (AR 40-25) for evaluating the nutritional adequacy of individual foods and menus. Nutrient density is defined as the nutrient concentration per 1000 Calories and is usually based on the nutritional requirements of individuals with the lowest energy needs (57-58). Although individuals with higher

energy requirements may consume higher than needed amounts of these nutrients it is unlikely that this could pose any real problems.

The nutrient density of the Ration, Lightweight is especially high because each 2000 kcal ration (if issued on a one-per-day basis as intended) is fortified to meet the MRDA. Although the micronutrient quality of the diet went down when the CHO supplement was added, nutrient density values, as can be seen in Table 9, are in the recommended range. However, if a soldier has an extremely low dietary intake, nutrient density standards for micronutrients could be met without meeting macronutrient needs.

Any sodium consumed in excess of the metabolic requirement will be excreted, thus increasing the urine void volume for that day. As with protein, a low but adequate amount of this mineral will spare body water by reducing the amount that is needed to excrete excess amounts of sodium. If water availability is a problem, food should be selected to reduce sodium intakes to the 3 to 9 g/day range.

The new Recommended Dietary Allowances (RDA) has recategorized sodium and now reports it as an "estimated minimum requirement" (EMR) value instead of an "estimated safe and adequate daily dietary intake" value. The EMR is now 500 mg sodium/day for an adult under a variety of physical and environmental conditions (34). As reported by the Continuing Survey of Food Intakes by Individuals (CSFII) men ages 20-39 consume on average 3,800 mg sodium/day (54). Recent research shows that the enlisted soldiers while in garrison consume approximately 5000 to 6000 mg sodium/day (59). The MRDA is set at a "safe and adequate level" of 1700 mg sodium/1000 kcal or approximately 5500 mg sodium/day (28). Nutritional standards for operational and restricted rations which are defined as minimum standards at the time of ration consumption are 5000 to 7000 mg sodium/day for operational rations and 2500 to 3500 mg sodium/day for restricted rations (28). The subjects in this study consumed on average 1300 mg sodium/1000 kcal or 3200 mg sodium/day, an appropriate level for water conservation.

TABLE 9 NUTRIENT DENSITY INDEX PER 1000 CALORIES FOR RLW RATION WITH AND WITHOUT CARBOHYDRATE SUPPLEMENT RELATIVE TO AR-40-25 GUIDELINES

NUTRIENT	AR-40-25	RLW	RLW+SUPPL
PROTEIN, g	33	38	29
VITAMIN A, mcg RE	333	596	458
ASCORBIC ACID, mg	25	67	52
THIAMIN (B1), mg	0.5	1.2	0.9
RIBOFLAVIN (B2), mg	0.6	1.6	1.2
NIACIN, mg	6.7	18.7	14.4
CALCIUM, mg	333	568	437
PHOSPOROUS, mg	333	673	457
MAGNESIUM, mg	125	270	208
IRON, mg	6.0	13.4	10.3
SODIUM, mg	1700	1664	1280

RATION AND LIQUID CHO SUPPLEMENT ACCEPTABILITY

The main points emerging from the questionnaire data were: Water melted from snow was the most frequently consumed beverage at or between meals. The usage data suggested that the majority of fruit flavored beverages could probably be eliminated from the ration without adverse effects on nutrition or acceptability. Although there were only ten subjects in this test and the environmental conditions were unusually extreme, at least two of the food groups, bread crisps and dairy bars are candidates for improvement or elimination. Doing so is not likely to reduce variety or ration acceptability significantly in a short term subsistence scenario such as the present exercise.

CONCLUSIONS

1. Liquid CHO supplementation made a significant contribution to CHO and water intake during this physically demanding field training exercise. However, total CHO intake (332 g/day) did not meet the 400 g CHO/day minimum needed to prevent a transition from a carbohydrate- to a fat-predominant metabolism.

2. This and other research suggests soldiers consuming field rations during field training exercises are normally in a negative energy balance. This is a result of high rates of energy expenditure combined with an apparent 3000 kcal/man/day limit to ration energy intake.

3. While fat energy deficits are normally met by drawing on large body fat reserves, liquid or solid carbohydrate supplementation or enhancement is needed to promote carbohydrate and water balance and minimize the impact of anorexia on soldier performance.

4. The consumption of RLW should not necessarily be expected to double when 2 rations per day are issued. It should not be utilized for high altitude field operations unless a carbohydrate supplement is concurrently provided.

RECOMMENDATIONS

1. Liquid and solid carbohydrate ration supplements fortified with micronutrients should be developed and type-classified. These supplements would minimize the impact of anorexia on soldier performance by increasing water and carbohydrate intake.

2. The numbers of fruit flavored beverage choices should be reduced particularly for cold weather exercises. Coconut and orange-nut bread crisps from the RLW should be improved or deleted since consumers under these conditions apparently considered these flavor variations unacceptable with a bread crumb base product. The orange-pineapple-coconut variation of the dairy bar group should be improved or deleted.

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APPENDIX A

VOLUNTEER AGREEMENT AFFIDAVIT

VOLUNTEER AGREEMENT AFFIDAVIT

For use of this form, see AR 70-25, the proponent agency is OTSG

PRIVACY ACT OF 1974

Authority	10 USC 3013, 44 USC 3101, and 10 USC 1071-1087
Principle Purpose	To document voluntary participation in the Clinical Investigation and Research Program. SSN and home address will be used for identification and locating purposes
Routine Uses	The SSN and home address will be used for identification and locating purposes. Information derived from the study will be used to document the study, implementation of medical programs, evaluation of claims, and for the mandatory reporting of medical conditions as required by law. Information may be furnished to Federal, State and local agencies
Disclosure	The furnishing of your SSN and home address is mandatory and necessary to provide identification and to contact you if future information indicates that your health may be adversely affected. Failure to provide the information may preclude your voluntary participation in this investigational study

PART A(1) - VOLUNTEER AFFIDAVIT

Volunteer Subjects in Approved Department of the Army Research Studies

Volunteers under the provisions of AR 40-38 and AR 70-25 are authorized all necessary medical care for injury or disease which is the proximate result of their participation in such studies.

I, _____, SSN _____,

having full capacity to consent and having attained my _____ birthday, do hereby volunteer/give consent as legal

representative for _____ to participate in _____

_____

(Research study)

_____

under the direction of _____

conducted at _____

(Name of institution)

The implications of my voluntary participation/consent as legal representative, duration and purpose of the research study, the methods and means by which it is to be conducted, and the inconveniences and hazards that may reasonably be expected have been explained to me by

_____

I have been given an opportunity to ask questions concerning this investigational study. Any such questions were answered to my full and complete satisfaction. Should any further questions arise concerning my rights/the rights of the person I represent on study related injury, I may contact

_____

at _____

(Name, Address and Phone Number of Hospital (Include Area Code))

I understand that I may at any time during the course of this study revoke my consent and withdraw/have the person I represent withdrawn from the study without further penalty or loss of benefits, however, I/the person I represent may be required (military volunteer) or requested (*civilian volunteer*) to undergo certain examination if, in the opinion of the attending physician, such examinations are necessary for my/the person I represent's health and well-being. My/the person I represent's refusal to participate will involve no penalty or loss of benefits to which I am/the person I represent is otherwise entitled.

_____

PART A (2) - ASSENT VOLUNTEER AFFIDAVIT *(MINOR CHILD)*

I, _____, SSN _____ having full

capacity to consent and having attained my _____ birthday, do hereby volunteer for _____

_____ to participate in _____

_____

(Research Study)

_____

under the direction of _____

conducted at _____

(Name of Institution)

(Continue on Reverse

PART A(2) - ASSENT VOLUNTEER AFFIDAVIT (*MINOR CHILD*) (Cont'd.)

The implications of my voluntary participation, the nature, duration and purpose of the research study; the methods and means by which it is to be conducted, and the inconveniences and hazards that may reasonably be expected have been explained to me by

_____

I have been given an opportunity to ask questions concerning this investigational study. Any such questions were answered to my full and complete satisfaction. Should any further questions arise concerning my rights I may contact:

_____

_____

(Name, Address, and Phone Number of Hospital, Include Area Code)

I understand that I may at any time during the course of this study revoke my assent and withdraw from the study without further penalty or loss of benefits. However, I may be requested to undergo certain examination if, in the opinion of the attending physician, such examinations are necessary for my health and well being. My refusal to participate will involve no penalty or loss of benefits to which I am otherwise entitled.

_____

PART B - TO BE COMPLETED BY INVESTIGATOR

INSTRUCTIONS FOR ELEMENTS OF INFORMED CONSENT (*Provide a detailed explanation in accordance with Appendix E, AR 40-38 or AR 70-25*)

Description

We are requesting your participation in a research study on ration consumption and energy expenditure during and in the week after your cold weather, high altitude field training exercise on Mount Rainier. The testing for this study will be carried out at Ft. Lewis, WA, and at the Mt. Rainier National Park. The purpose of this study is to measure your energy expenditure and evaluate the Ration Lightweight (RLW) as your sole source of food while you are engaged in your training.

The total time period of the study is 26 days (6-31 March 1989). With the exception of water obtained by melting snow during your field exercise on Mt. Rainier, you will be asked to drink only the water provided to you by the research team starting on 6 March and continuing until the end of the experiment on 31 March, 1989. You will be asked to avoid all other sources of water, including beer, wine, soda, etc.. This will permit accurate measurements of your energy expenditure to be made.

Before and after your field exercise during 13-18 March and 25-27 March, you will be asked to participate in two days of testing requiring a total of 16 hours of your time. During each day of your 6 day field exercise on Mt. Rainier (19-24 March) you will be asked to maintain in a small booklet a log of the rations you consume and the water you drink, fill out a simple questionnaire on how you feel physically, and collect a urine and saliva sample. These field activities should take less than an hour each day.

I do ☐ do not ☐ (*check one & initial*) consent to the inclusion of this form in my outpatient medical treatment record.

SIGNATURE OF VOLUNTEER	DATE	SIGNATURE OF LEGAL GUARDIAN (*If volunteer is a minor*)
PERMANENT ADDRESS OF VOLUNTEER	TYPED NAME OF WITNESS	
	SIGNATURE OF WITNESS	DATE

REVERSE OF DA FORM 5303-R, MAY 88

PART B - TO BE COMPLETED BY INVESTIGATOR (cont'd)

At the end of the test you will be asked to fill out a questionnaire on the taste, packaging and ease of use of the rations. We also wish to record your activity patterns with a small, lightweight battery-powered device which is simply strapped to your wrist. There is no chance of electrical shock. You will be asked to wear one of these monitors starting on 18 March and ending on 31 March, 1989. You will also be asked to provide a sample of your first morning urine on Monday 27 March, and on Friday 31 March, 1989. This final urine sample, along with the information from your activity monitor, will be used to estimate your energy expenditure and acivity patterns during sea level training.

Venous blood samples will be collected before and after your field training exercise. Blood samples will be collected with a small sterile needle from an arm vein by skilled personnel. These procedures involve very little chance of injury beyond the possibility of bruising and temporary discomfort. This procedure is no different than having blood taken in the doctor's office or in a hospital clinic. The total amount of blood withdrawn over the course of the study will be less than two tablespoons. These blood samples will help us to monitor the state of your metabolism.

We will measure your resting oxygen consumption twice. Once before you go into the field, and once when you return from the field. This involves lying quietly for 20-30 minutes while wearing a noseclip and breathing through a rubber mouthpiece so the amount of oxygen you are using can be measured.

Your body fat will also be estimated by measuring the cirumferences of your neck and limbs and by underwater weighing before and after your field training exercise. We also wish to estimate the relative portions of your body that are fat as well as other components such as muscle by weighing you in air first and again while you are submerged in water. The underwater weighing is performed by having you sit in a shallow tank of warm water and placing your head in a forward position into the water, and holding your breath for 10 seconds while your weight is recorded.

We wish to measure the volume of water in your body and the rate at which you expend energy. We will do this by having you drink modified water that contains a non-radioactive substance. The modified water you will drink is safe. We will allow time for the modified water you drink to mix with your body water (3 to 4 hours) and then we will collect samples of saliva and urine for chemical analysis. Total body water will be calculated by measuring the dilution of the modified water in your saliva and urine. You will be asked to collect small samples (teaspoons) of your urine and saliva each day while you are in the field, and at the beginning and end of the week after your field training exercise. These samples will be used to determine your energy expenditure in the field from the rate of excretion of modified water from your body. When you return from the field you will be given a second dose of modified water to drink so that a final determination of your total body water can be made.

Risks and Benefits

The risks of participating in this study are those associated with having venous blood drawn and underwater weighing. There are no known risks associated with the ingestion of modified water containing a safe, naturally occurring substance, or with the use of the activity monitor. Skilled personnel will use sterile techniques to perform the needle puncture of veins in the extremities. There may be some discomfort associated with the skin puncture when venous blood is drawn. There is a chance that an infection or bruise may develop at the site of the puncture.

SIGNATURE OF VOLUNTEER	DATE SIGNED	SIGNATURE OF LEGAL GUARDIAN, IF VOLUNTEER IS A MINOR
PERMANENT ADDRESS OF VOLUNTEER	TYPED OR PRINTED NAME AND SIGNATURE OF WITNESS	DATE SIGNED

Reverse of DA FORM 8303 R

PART B - TO BE COMPLETED BY INVESTIGATOR (cont'd)

During underwater weighing there is a slight risk that you could inhale a mouth full of water with some going into your windpipe or your lungs. We have safeguarded against this possibility by having you wear a nose clip and having you breath through a mouthpiece sealed by your lips and connected to a snorkel tube which extends above the water (into the room air) while underneath the water. Thus, it is not possible to inhale water except by removing the mouthpiece or nose clip. An investigator is in direct observation and contact with you and will raise you out of the water if (in the unlikely event) you should experience difficulty. A Medical Monitor (physician) will oversee all of the testing for your health and safety.

This study is voluntary and you may withdraw at any time without penalty or loss of benefits to which you would otherwise be entitled. You will receive a copy of this consent form, and you may ask as many questions as you like. You will receive no direct benefits from your participation in this study other than the knowledge and experience you may gain from the medical examination and study procedures. The potential benefits to you result from participating in this study are as follows: You will have the personal satisfaction of knowing that you have made an important contribution to the fielding of a new ration system that may help you complete your mission. Your data, comments and suggestions will be carefully evaluated and may lead to beneficial changes in the design and/or content of this ration. The data gathered in this study may be published in a scientific journal and contribute to our understanding of the physiology of man during exercise at high altitude in cold weather.

If you have any questions concerning this study or your results, you may contact Dr. Reed W. Hoyt, U.S. Army Research Institute of Environmental Medicine, Natick, MA 01760-5007, telephone number (508) 651-4802. All data and medical information obtained about you as an individual will be considered priviledged and held in confidence. Complete confidentiality can not be promised, particularly to subjects who are military members, because information bearing on your health may be required to be reported to appropriate medical or Command authorities, and applicable regulations note the possibility that the Food and Drug Administration and USAMRDC officials may inspect the records.

SIGNATURE OF VOLUNTEER	DATE SIGNED	SIGNATURE OF LEGAL GUARDIAN (If applicable)	
PERMANENT ADDRESS OF VOLUNTEER	TYPED OR PRINTED NAME AND SIGNATURE OF WITNESS		DATE SIGNED

Reverse of DA FORM 5303-R

APPENDIX B

OPERATIONAL SCENARIO

OPERATIONAL SCENARIO

Friday 17 March 89

Pre-FTX physiological testing at Ft Lewis, Seattle Veteran's Administration Hospital, and Harborview Medical Center (0500-1500).

Saturday 18 March 89

Pre-FTX physiological testing at Ft Lewis and body fat determination at Seattle Veteran's Administration Hospital(0400-1500)

Sunday 19 March 89

Depart at 1400 hours for Mt Rainier National Park, Paradise visitor's area.

1st Movement 2 hours with 20 minute rest period
2nd movement 30 minutes with 15 minutes rest period
3rd movement 1 hour

End of day 1800 hours: prepared bivouac site at Panorama Point by digging snow wall, pitching tents and making dinner.

Monday 20 March 89

Morning activities: melted snow for water, prepared breakfast and packed equipment. Crevasse rescue training and movement at 1300 to 2030 to Muir snowfields. End of day: Prepared emergency bivouac (dug snow wall and pitched tents) about 1 kilometer south of Camp Muir, in 50 mph east winds.

Tuesday 21 March 89

Morning: Seven member main element climbs to Camp Muir at 1045 to 1400. Three member party, consisting of injured person and two assistants, begin return to Paradise visitor's area.

Wednesday 22 March 89

Rest day at Camp Muir in anticipation of summit attempt in late evening. Descending party not yet arrived at Paradise ranger station.

Thursday 23 March 89

Climb aborted due to unknown status of three man party on way down to Paradise visitor's area. Packed equipment from 0600 to 0700. Movement from Camp Muir to Paradise visitor's area 0700 to 1245 hours. Notified at 0730 that the 3-man element was safe.

Friday 24 March 89

Post-FTX physiological testing at Ft Lewis, Seattle Veteran's Administration Hospital, and Harborview Medical Center (0500-1500)

Saturday 25 March 89

Post-FTX physiological testing at Ft Lewis and body fat determination at Seattle Veteran's Administration Hospital (0400-1500)

End of Mission

APPENDIX C

RATION, LIGHTWEIGHT LOG BOOKS, INFORMATION PAPER, MENUS AND NUTRIENT COMPOSITION TABLE, AND POST TEST QUESTIONNAIRE

RATION LIGHT WEIGHT

Name _____

Test Subject Number _____

This is your log book to record the quantity of food and water you consume each day for six days. These log books will be collected at the end of the 6 day period. While the recording of this data may be tedious and repetitious to you, it is very important that you be as thorough and complete as possible. This data will be used to calculate whether or not you received adequate nutrition (recommended dietary allowances) each day. You must fill these pages out daily. A quick entry after each meal will help you avoid forgetting to mark down food items or fluids consumed. Thank you for your cooperation.

DAY 1

LIGHT WEIGHT RATION CONSUMPTION
Circle the number that indicates how much of each item you ate today. If you ate an amount that is not listed, write it on the line to the right.
For ex: If you eat 3 Bran Flakes bars, write 3

FOOD ITEM	CODE	AMOUNT CONSUMED (BY PACKAGE)					
CEREAL BARS							
BRAN FLAKES	100	1/4	1/2	3/4	1	2	____
CORN FLAKES	101	1/4	1/2	3/4	1	2	____
MALTED WHEAT GRANULES	102	1/4	1/2	3/4	1	2	____
OAT CEREAL BISCUITS	103	1/4	1/2	3/4	1	2	____
SHREDDED WHEAT	104	1/4	1/2	3/4	1	2	____
WHEAT FLAKES	105	1/4	1/2	3/4	1	2	____
ENTREES							
BEEF STEW	106	1/4	1/2	3/4	1	2	____
CHICKEN A LA KING	107	1/4	1/2	3/4	1	2	____
CHICKEN W/RICE AND HAM	108	1/4	1/2	3/4	1	2	____
CHILI CON CARNE	109	1/4	1/2	3/4	1	2	____
PORK WITH RICE	110	1/4	1/2	3/4	1	2	____
SPAGHETTI W/MEAT + SAUCE	111	1/4	1/2	3/4	1	2	____
BEEF JERKY	112	1/4	1/2	3/4	1	2	____
BREAD CRISP							
BACON CHEESE	113	1/4	1/2	3/4	1	2	____
COCONUT	114	1/4	1/2	3/4	1	2	____
NACHO CHEESE	115	1/4	1/2	3/4	1	2	____
ORANGE NUT	116	1/4	1/2	3/4	1	2	____
PIZZA	117	1/4	1/2	3/4	1	2	____
TAMALE	118	1/4	1/2	3/4	1	2	____
DAIRY BARS							
ALMOND	119	1/4	1/2	3/4	1	2	____
BANANA	120	1/4	1/2	3/4	1	2	____
MIXED NUT	121	1/4	1/2	3/4	1	2	____
ORANGE PINEAPPLE COCONUT	122	1/4	1/2	3/4	1	2	____
STRAWBERRY	123	1/4	1/2	3/4	1	2	____
VANILLA	124	1/4	1/2	3/4	1	2	____

DAY 1 CONTINUED

FOOD ITEM	CODE	AMOUNT CONSUMED (BY PACKAGE)					
DESSERT BARS							
APPLE CINNAMON	125	1/4	1/2	3/4	1	2	___
BLUEBERRY	126	1/4	1/2	3/4	1	2	___
CHOCOLATE CHIP	127	1/4	1/2	3/4	1	2	___
CHOCOLATE HALVA	128	1/4	1/2	3/4	1	2	___
GRAHAM	129	1/4	1/2	3/4	1	2	___
PECAN	130	1/4	1/2	3/4	1	2	___
DRINKS							
COCOA	131	1/4	1/2	3/4	1	2	___
COFFEE	132	1/4	1/2	3/4	1	2	___
CREAM SUBSTITUTE	133	1/4	1/2	3/4	1	2	___
LEMONADE BEVERAGE	134	1/4	1/2	3/4	1	2	___
ORANGE BEVERAGE	135	1/4	1/2	3/4	1	2	___
RASPBERRY BEVERAGE	136	1/4	1/2	3/4	1	2	___
STRAWBERRY BEVERAGE	137	1/4	1/2	3/4	1	2	___
TROPICAL PUNCH BEVERAGE	138	1/4	1/2	3/4	1	2	___
LEMON-LIME BEVERAGE	139	1/4	1/2	3/4	1	2	___
TEA	140	1/4	1/2	3/4	1	2	___
OTHER							
GUM	141	1/4	1/2	3/4	1	2	___
HOT SAUCE	142	1/4	1/2	3/4	1	2	___
CARBOHYDRATE DRINK	143	1	2	3	4	5	___

4

DAY 1
WATER CONSUMPTION

Canteen Number	Amount Put In Canteen 1000 ml	Amount Thrown Away or Leftover	Circle Type of Fluid In Canteen
_____	_____	_____	Plain Water CHO Beverage
_____	_____	_____	Plain Water CHO Beverage
_____	_____	_____	Plain Water CHO Beverage
_____	_____	_____	Plain Water CHO Beverage
_____	_____	_____	Plain Water CHO Beverage
_____	_____	_____	Plain Water CHO Beverage
_____	_____	_____	Plain Water CHO Beverage
_____	_____	_____	Plain Water CHO Beverage
_____	_____	_____	Plain Water CHO Beverage
_____	_____	_____	Plain Water CHO Beverage

5

DAY 1

COMMENTS AND NOTES:

STRNC-WTP (70-1ff) 7 August 1990

FACT SHEET

SUBJECT: Ration, Lightweight-30 Days (RLW-30)

PURPOSE: To describe the RLW-30 program.

BACKGROUND:

- Requirement: Lightweight, calorie dense ration for Special Operations Forces (SOF) Soldier in clandestine operations up to 30 days without resupply.
- Deficiency: Subsistence items and rations currently available are too bulky or heavy, denying space for mission essential equipment.
- Ration Description:
  - Ration is eaten as is, or with minimum preparation and limited water supply.
  - Six day menu cycle with separate accessory packet for every six days.
  - Ration weighs less than one pound and volume is under 45 cubic inches (737 cc).
  - Daily menu contains 2,132 kilocalories, consisting of 202 grams of carbohydrate, 72 grams of protein, and 115 grams of fat.
  - Ration is composed of eight types of dehydrated bars representing entrees, bread crisp, cereal, dessert, dairy, cocoa, and fruit beverage bars plus beef jerky.
- Status:
  - Ration has been successfully field evaluated for 7 and 12 day periods.
  - Successful 30-day test (DT/OT) was conducted in 1QFY87.
  - A Special In-Process Review was conducted in 4QFY89 and the ration was approved for use by the SOF only.
  - Specifications have been coordinated and transferred to Defense Personnel Support Center.
  - Contract award is scheduled for 2QFY91.
  - Fielding of RLW-30 is scheduled for 4QFY91.

Carol P. Shaw/5038
AV256-5038

Comparison with Other Rations:

	Meal, Ready-to-Eat (one meal)	Long Range Patrol	Ration Cold Weather	RLW-30
Weight (g)	667	318	1220	445
Volume (cc)	96	79	183	45
Kilocalories	1298	1100	4475	2132
CHO (g)	146	120	656	202
Protein (g)	48	51	120	72
Fat (g)	51	50	152	115
Kcal/g (packaged)	1.9	3.5	3.7	4.8
Kcal/cc (packaged)	0.8	0.9	1.5	2.9

Menu Contents

Menu #1

Chicken A La King
Cheese Bread Crisp
Almond Dairy Bar
Blueberry Dessert Bar
Shredded Wheat Cereal Bar
Tropical Punch Beverage Bar
Cocoa Beverage Bar
Beef Snacks
Mixing Bag

Menu #2

Beef Stew
Tamale Bread Crisp
Strawberry Dairy Bar
Chocolate Chip Dessert Bar
Wheat Flake Cereal Bar
Lemonade Beverage Bar
Cocoa Beverage Bar
Beef Snacks
Mixing Bag

Menu #3

Pork with Rice
Pizza Bread Crisp
Pecan Dairy Bar
Apple Cinnamon Dessert Bar
Bran Flake Cereal Bar
Orange Beverage Bar
Cocoa Beverage Bar
Beef Snacks
Mixing Bag

Menu #4

Chicken with Rice and Ham
Cheese-Bacon Bread Crisp
Orange Creamsicle Dairy Bar
Pecan Dessert Bar
Oat Cereal Biscuit Bar
Lemon-Lime Beverage Bar
Cocoa Beverage Bar
Beef Snacks
Mixing Bag

Menu #5

Spaghetti with Meat and Sauce
Coconut Bread Crisp
Mixed Nut Dairy Bar
Chocolate Halva Dessert Bar
Malted Wheat Granules Cereal Bar
Strawberry Beverage Bar
Cocoa Beverage Bar
Beef Snacks
Mixing Bag

Menu #6

Chili Con Carne
Orange-Nut Bread Crisp
Maple Walnut Dairy Bar
Graham Dessert Bar
Corn Flakes Cereal Bar
Raspberry Beverage Bar
Cocoa Beverage Bar
Beef Snacks
Mixing Bag

RECORD OF NUTRITIVE VALUES RATION EIGHT WEIGHT

02/16/89

TOTALS	WATER (G)	PROTEIN (G)	FAT (G)	ASH (G)	CALCIUM (MG)	PHOS (MG)	IRON (MG)	SODIUM (MG)	POTASS (MG)	MAGNESIUM (MG)	NACL (G)	ZINC (MG)	CHOLESTROL (MG)
1	17.93	82.59	116.08	15.41	1030	1378	25.31	3296	2251	626	7.21	101.25	181
2	20.68	64.64	118.19	15.46	1004	1220	30.05	3555	2197	464	7.60	20.87	137
3	20.71	65.56	115.97	15.19	937	1299	36.73	3554	2040	502	7.65	16.50	134
4	20.10	67.06	119.25	14.96	1028	1353	32.00	3494	2011	450	7.01	19.43	157
5	19.75	77.87	113.35	17.99	1023	1369	26.93	4125	2693	479	8.90	102.52	151
6	21.42	71.87	109.35	15.16	949	1291	26.09	3505	2231	309	7.44	103.95	165
MEAN	20.10	71.60	115.40	15.69	995	1401	29.52	3588	2237	471	7.64	59.25	152

	A (IU)	CAROTENE (MG)	TOTAL A (IU)	C (MG)	B1 (MG)	B2 (MG)	NIACIN (MG)	B6 (MG)	FOLACIN (MCG)	B12 (MCG)	E (MG)	CHO (G)	CALORIES	WEIGHT (G)
1	2950	.288	3430	136	2.29	2.35	36.4	2.05	348	3.34	44.52	190.19	2136	422
2	3650	1.154	5570	142	2.23	2.62	30.0	2.50	412	3.73	42.23	193.54	2096	412
3	4580	.079	4710	115	2.77	2.70	28.7	2.83	405	3.35	45.98	203.58	2120	421
4	2590		2590	111	2.87	2.60	32.6	1.99	322	3.56	46.14	199.02	2138	420
5	4320	.076	4450	120	2.69	2.82	36.3	3.94	508	5.50	41.60	215.65	2194	445
6	3240	.945	4810	135	2.33	2.82	33.9	3.22	452	3.89	42.63	209.30	2111	427
MEAN	3555	.508	4260	127	2.53	2.65	33.0	2.76	408	3.89	43.85	201.88	2132	425

PERCENT OF CALORIES FROM- PROTEIN - 13 PERCENT
FAT - 49 PERCENT
CHO - 38 PERCENT

RECORD OF NUTRITIVE VALUES RATION EIGHT WEIGHT

02/16/89

MENU 1	WATER (G)	PROTEIN (G)	FAT (G)	ASH (G)	CALCIUM (MG)	PHOS (MG)	IRON (MG)	SODIUM (MG)	POTASS (MG)	MAGNESIUM (MG)	NACL (G)	ZINC (MG)	CHOLESTROL (MG)
CHIX ALA KNG	1.16	35.78	15.67	4.31	74	350	1.40	1140	710	61	2.74	1.38	83
CHES BREAD B	.38	5.50	14.82	1.78	87	121	10.90	189	64	381	81	91.74	6
ALMND DA RY	1.16	6.48	23.41	1.05	134	143	.57	83	233	49	.19	.87	20
BLUEBERY BAR	1.68	4.28	19.17	.49	11	75	1.02	140	84	20	.22	.53	6
SHR WHEAT BR	1.71	6.54	16.58	1.68	72	155	1.38	352	219	43	.72	1.42	13
TROPPC BEVRR	1.26	.09	.90	1.75	606	214	.72	11	195	4	.01	.54	
COCOA BEV BR	1.09	3.45	16.64	1.24	41	151	2.16	146	394	46	.21	.47	10
BEEF JERKY	9.50	20.47	8.89	3.09	6	169	2.17	1031	353	23	2.31	4.30	43
SUM	17.93	82.59	116.09	15.41	1030	1378	25.31	3296	2251	626	7.21	101.25	181

	A (IU)	CAROTENE (MG)	TOTAL A (IU)	C (MG)	B1 (MG)	B2 (MG)	NIACIN (MG)	B6 (MG)	FOLACIN (MCG)	B12 (MCG)	E (MG)	CHO (G)	CALORIES	WEIGHT (G)
CHIX ALA KNG	320	288	800		16	22	16.1	22	28	.21	1.59	12.28	333	69
CHES BREAD B	130		130		49	14	1.5	02	9		2.29	19.21	232	42
ALMND DAIRY	440		440		04	24	5	02	10	.17	13.54	11.30	282	43
BLUEBERY BAR	160		160		17	09	9	08	17		3.20	27.78	301	53
SHR WHEAT BR	400		400		06	14	2.3	06	9		3.83	44.49	353	71
TROPPC BEVRR				1.36								49.90	208	54
COCOA BEV BR	1500		1500	0	1.33	1.32	9.0	1.60	273	2.01	18.64	24.18	260	47
BEEF JERKY					05	20	6.0	04	4	.95	1.42	1.05	166	43
SUM	2950	288	3430	1.36	2.29	2.35	36.4	2.05	348	3.34	44.52	190.19	2136	422

RECORD OF NUTRITIVE VALUES RATION LIGHT WEIGHT

02/16/89

MENU 2	WATER (G)	PROTEIN (G)	FAT (G)	ASH (G)	CALCIUM (MG)	PHOS (MG)	IRON (MG)	SODIUM (MG)	POTASS (MG)	MAGNESIUM (MG)	NACL (G)	ZINC (MG)	CHOLESTROL (MG)
BEEF STEW	1.28	20.22	16.79	3.87	30	193	2.31	1103	567	40	2.44	2.52	28
TAMALE BREAD	.33	5.52	14.07	1.87	94	114	11.33	467	87	242	1.02	11.37	6
STRW DAIRY B	1.41	4.64	21.08	.86	126	97	.27	62	216	17	.17	.42	34
CHOCCHIP BAR	.84	4.81	22.85	.79	15	112	1.63	161	168	47	.32	1.12	6
WHEATIES BAR	1.86	5.47	15.39	2.09	108	137	4.58	578	231	40	1.12	.67	11
LEMON BEVBR	4.38	.05	2.49	1.65	585	247	.60	7	181	7	.02	.00	
COCOA BEV BR	1.09	3.45	16.64	1.24	41	151	2.16	146	394	46	.21	.47	10
BEEF JERKY	9.50	20.47	8.89	3.09	6	169	7.17	1031	353	23	2.31	4.30	43
SUM	20.68	64.64	118.19	15.46	1004	1220	30.05	3555	2197	461	7.60	20.87	137

	A (IU)	CAROTENE (MG)	TOTAL A (IU)	C (MG)	B1 (MG)	B2 (MG)	NIACIN (MG)	B6 (MG)	FOLACIN (MCG)	B12 (MCG)	E (MG)	CHO (G)	CALORIES	WEIGHT (G)
BEEF STEW		1.032	1720		.14	.18	4.7	16	13	.57	1.01	20.84	315	63
TAMALE BREAD	220	.122	420		.21	.15	1.8	.02	11		2.27	18.81	224	41
STRW DAIRY B	410		410	28	.03	.16	.3	.03	7	.21	12.53	13.91	264	42
CHOCCHIP BAR	170		170		.17	.13	1.1	.08	9		2.86	26.71	332	56
WHEATIES BAR	1350		1350	7	30	.47	7.2	.57	95		3.51	42.70	331	68
LEMON BEVBR				106								45.32	204	54
COCOA BEV BR	1500		1500	0	1.33	1.32	9.0	1.60	273	2.01	18.64	24.18	260	47
BEEF JERKY					.05	.20	6.0	.04	4	.95	1.42	1.05	166	43
SUM	3650	1.154	5570	142	2.23	2.62	30.0	2.50	412	3.73	42.23	193.54	2096	412

RECORD OF NUTRITIVE VALUES RATION LIGHT WEIGHT

02/16/89

MENU 3	WATER (G)	PROTEIN (G)	FAT (G)	ASH (G)	CALCIUM (MG)	PHOS (MG)	IRON (MG)	SODIUM (MG)	POTASS (MG)	MAGNESIUM (MG)	NACL (G)	ZINC (MG)	CHOLESTROL (MG)
PORK W RICE	1.30	22.43	9.22	3.84	32	258	1.46	1139	472	39	2.65	2.85	36
PIZZA BREAD	.37	5.34	12.81	1.80	94	109	12.00	397	92	292	81	2.35	6
VAN DAIRY	.80	3.44	25.89	.77	91	88	.14	137	142	10	.32	.41	27
APPLCIN DBAR	1.65	3.86	22.60	.48	19	79	.91	115	98	22	.16	1.07	1
BRAN FLKS BR	1.68	6.51	16.95	2.34	80	201	12.28	583	299	63	1.19	5.06	13
ORNGE BEVBR	4.32	05	2.97	1.63	574	244	.61	6	190	7	.02	.00	
COCOA BEV BR	1.09	3.45	16.64	1.24	41	151	2.16	146	394	46	.21	.47	10
BEEF JERKY	9.50	20.47	8.89	3.09	6	169	7.17	1031	353	23	2.31	4.30	43
SUM	20.71	65.56	115.97	15.19	937	1299	36.73	3554	2040	502	7.65	16.50	134

	A (IU)	CAROTENE (MG)	TOTAL A (IU)	C (MG)	B1 (MG)	B2 (MG)	NIACIN (MG)	B6 (MG)	FOLACIN (MCG)	B12 (MCG)	E (MG)	CHO (G)	CALORIES	WEIGHT (G)
PORK W RICE					.67	.23	5.3	.23	7	.14	.64	34.41	310	71
PIZZA BREAD	570	.079	700		.20	.15	1.8	.02	11		2.70	18.79	212	39
VAN DAIRY	520		520		.02	14	.1	03	5	.25	15.77	10.50	289	41
APPLCIN DBAR	160		160		.13	.09	.7	.06	16		3.05	24.91	319	54
BRAN FLKS BR	1830		1830	8	.36	.58	5.7	84	90		3.76	44.80	358	72
ORNGE BEVBR				107								44.93	207	54
COCOA BEV BR	1500		1500	0	1.33	1.32	9.0	1.60	273	2.01	18.64	24.18	260	47
BEEF JERKY					05	.20	6.0	04	4	95	1.42	1.05	166	43
SUM	4580	.079	4710	115	2.77	2.70	28.7	2.83	405	3.35	45.98	203.58	2120	421

RECORD OF NUTRITIVE VALUES RATION LIGHT WEIGHT

02/16/89

MENU 4	WATER (G)	PROTEIN (G)	FAT (G)	ASH (G)	CALCIUM (MG)	PHOS (MG)	IRON (MG)	SODIUM (MG)	POTASS (MG)	MAGNESIUM (MG)	NACL (G)	ZINC (MG)	CHOLESTROL (MG)
CHIX W/RICE	.60	19.32	10.78	3.43	20	258	1.11	1173	380	36	2.57	1.40	34
CHES BCN BRD	.97	5.45	15.36	1.82	88	128	9.81	377	67	248	78	2.06	6
ORNG PA BAR	1.08	6.00	25.06	.81	116	108	.46	65	235	21	17	.45	20
OAT CERL BAR	1.71	7.67	16.23	2.17	140	195	9.66	469	291	46	85	.66	11
PECAN DES BR	.76	4.65	23.82	.73	40	103	1.04	227	105	23	.11	1.08	29
LEMLIM BEVBR	4.39	.05	2.46	1.67	577	241	.60	8	188	7	.02	00	
COCOA BEV BR	1.09	3.45	16.64	1.24	41	151	2.16	146	394	46	.21	.47	10
BEEF JERKY	9.50	20.47	8.89	3.09	6	169	7.17	1031	353	23	2.31	4.30	43
SUM	20.10	67.06	119.25	14.96	1028	1353	32.00	3494	2011	450	7.01	10.43	152

	A (IU)	CAROTENE (MG)	TOTAL A (IU)	C (MG)	B1 (MG)	B2 (MG)	NIACIN (MG)	B6 (MG)	FOLACIN (MCG)	B12 (MCG)	E (MG)	CHO (G)	CALORIES	WEIGHT (G)
CHIX W/RICE					.19	.13	8.8	18	8	.07	1.75	35.87	318	70
CHES BCN BRD	120		120		.46	.13	1.4	02	7		2.35	17.70	231	41
ORNG PA BAR	420		420		.03	16	2	03	5	.54	17.10	12.04	298	45
OAT CERL BAR	390		390		.30	53	6.4	.05	13		3.25	38.61	331	66
PECAN DES BR	160		160		.51	.12	7	07	14		1.63	24.24	330	54
LEMLIM BEVBR				111								45.32	204	54
COCOA BEV BR	1500		1500	0	1.33	1.32	9.0	1.60	273	2.01	18.64	24.18	260	47
BEEF JERKY					05	20	6.0	.04	4	.95	1.42	1.05	166	43
SUM	2590		2590	111	2.87	2.60	32.6	1.99	322	3.56	46.14	199.02	2138	420

RECORD OF NUTRITIVE VALUES RATION LIGHT WEIGHT

02/16/89

MENU 5	WATER (G)	PROTEIN (G)	FAT (G)	ASH (G)	CALCIUM (MG)	PHOS (MG)	IRON (MG)	SODIUM (MG)	POTASS (MG)	MAGNESIUM (MG)	NACL (G)	ZINC (MG)	CHOLESTROL (MG)
SPAGHETTI	1.68	33.48	14.26	7.06	167	409	3.44	1728	1123	85	3.95	6.05	54
COCONT BREAD	.85	2.97	14.78	.97	24	44	9.62	181	116	193	.43	88.43	3
MXD NUT DAIR	.84	5.07	24.92	.71	76	95	.38	96	149	22	.22	.80	25
CHOCHALV BAR	1.36	4.66	18.38	.82	15	113	1.74	169	125	64	.30	1.11	6
GRAPENUTS BR	3.17	7.68	14.64	2.35	75	157	1.67	763	236	42	1.48	.82	
STRWBR BEVBR	1.26	.09	.85	1.75	620	231	.74	10	197	4	.01	.54	
COCOA BEV BR	1.09	3.45	16.64	1.24	41	151	2.16	146	394	46	.21	47	10
BEEF JERKY	9.50	20.47	8.89	3.09	6	169	7.17	1031	353	23	2.31	4.30	43
SUM	19.75	77.87	113.35	17.99	1023	1369	26.93	4125	2693	479	8.90	102.52	141

	A (IU)	CAROTENE (MG)	TOTAL A (IU)	C (MG)	B1 (MG)	B2 (MG)	NIACIN (MG)	B6 (MG)	FOLACIN (MCG)	B12 (MCG)	E (MG)	CHO (G)	CALORIES	WEIGHT (G)
SPAGHETTI		.076	130		.32	.40	10.0	.32	22	.95	.69	29.92	382	86
COCONT BREAD	110		110		.34	.09	1.3	.01	8		1.81	17.43	215	37
MXD NUT DAIR	400		400		.07	.12	.2	.03	8	.12	13.68	8.46	278	40
CHOCHALV BAR	170		170		.16	.11	1.3	.03	8		1.50	30.48	306	56
GRAPENUTS BR	2140		2140		.43	.58	8.4	1.90	187	1.48	3.85	54.17	379	82
STRWBR BEVBR				120								49.95	208	54
COCOA BEV BR	1500		1500	0	1.33	1.32	9.0	1.60	273	2.01	18.64	24.18	260	47
BEEF JERKY					.05	.20	6.0	.04	4	.95	1.42	1.05	166	43
SUM	4320	.076	4450	120	2.69	2.82	36.3	3.94	508	5.50	41.60	215.65	2194	445

RECORD OF NUTRITIVE VALUES RATION LIGHT WEIGHT

02/16/89

MENU 6	WATER (G)	PROTEIN (G)	FAT (G)	ASH (G)	CALCIUM (MG)	PHOS (MG)	IRON (MG)	SODIUM (MG)	POTASS (MG)	MAGNESIUM (MG)	NACL (G)	ZINC (MG)	CHOLESTROL (MG)
CHILI KD BNS	1.65	30.17	16.00	4.55	89	908	3.75	1212	768	163	2.96	5.38	51
ORGN NUT BRD	.30	4.38	15.51	.81	17	72	9.80	186	84	22	.39	93.38	0
BAN DAIRY BR	.69	5.23	24.10	.78	104	101	.44	55	191	26	.14	.42	26
GRAHAM BAR	1.98	3.47	10.37	.97	46	69	.80	227	105	11	.11	.00	23
CORNFLKS BAR	1.90	4.65	15.38	2.06	56	73	1.33	641	146	10	1.31	.00	12
RASPBR BEVBR	4.31	.05	2.66	1.66	590	247	.61	7	191	8	.02	.00	
COCOA BEV BR	1.09	3.45	16.64	1.24	41	151	2.16	146	394	46	.21	.47	10
BEEF JERKY 1	9.50	20.47	8.89	3.09	6	169	7.17	1031	353	23	2.31	4.30	43
SUM	21.42	71.87	109.55	15.16	949	1791	26.09	3505	2231	309	7.44	103.95	165

	A (IU)	CAROTENE (MG)	TOTAL A (IU)	C (MG)	B1 (MG)	B2 (MG)	NIACIN (MG)	B6 (MG)	FOLACIN (MCG)	B12 (MCG)	E (MG)	CHO (G)	CALORIES	WEIGHT (G)
CHILI KD BNS		.945	1570		.13	.27	6.6	.21	28	.77	2.15	24.43	362	77
ORGN NUT BRD					.28	.13	1.4	.06	16		2.68	19.59	235	41
BAN DAIRY BR	380		380	24	.04	.15	2	.06	8	.17	12.59	11.60	284	42
GRAHAM BAR	500		500		.04	.13	.6	.03	2		1.75	37.92	259	55
CORNFLKS BAR	860		860		.45	.63	10.0	1.23	121		3.40	45.31	338	69
RASPBR BEVBR				110								45.22	205	54
COCOA BEV BR	1500		1500	0	1.33	1.32	9.0	1.60	273	2.01	18.64	24.18	260	47
BEEF JERKY 1					.05	.20	6.0	.04	4	.95	1.42	1.05	166	43
SUM	3240	.945	4810	135	2.33	2.82	33.9	3.22	452	3.89	42.63	209.30	2111	427

RATION, LIGHTWEIGHT (RLW) QUESTIONNAIRE

U.S. Army Natick Research, Development and Engineering Center
Natick, Massachusetts 01760

We are interested in your honest reactions to the Ration, Lightweight (RLW) which you ate during the cold weather field test. Your responses to these questions are important to the development of this ration and are confidential.

1. How long have you been in the Armed Forces? _____years, _____months.

2. What is your rank? _____ Age? _____

3. Before this exercise, have you been in the field with only operational rations (like MRE, MCI, etc.) to eat?____

   a If so, how many times? _____

   b. What was the average length of the exercise? _____days

4. How would you describe the weather in general during this exercise? Please circle one number.

NOT COLD	SOMEWHAT COLD	MODERATELY COLD	EXTREMELY COLD
1	2	3	4

5. Please use the following scale to indicate how much you like or dislike each of the RLW items you ate during the exercise by circling the number that best expresses your opinion.

NEVER TRIED	DISLIKE EXTREMELY	DISLIKE VERY MUCH	DISLIKE MODERATELY	DISLIKE SLIGHTLY	NEITHER LIKE NOR DISLIKE	LIKE SLIGHTLY	LIKE MODERATELY	LIKE VERY MUCH	LIKE EXTREMELY
0	1	2	3	4	5	6	7	8	9

1. Chicken ala King	0	1	2	3	4	5	6	7	8	9
2. Pork with Rice	0	1	2	3	4	5	6	7	8	9
3. Spaghetti w/Meat Sauce	0	1	2	3	4	5	6	7	8	9
4. Beef Stew	0	1	2	3	4	5	6	7	8	9
5. Chicken w/Rice and Ham	0	1	2	3	4	5	6	7	8	9
6. Chili Con Carne	0	1	2	3	4	5	6	7	8	9
7. Nacho Cheese Bread	0	1	2	3	4	5	6	7	8	9
8. Pizza Bread	0	1	2	3	4	5	6	7	8	9

PLEASE TURN OVER

NEVER TRIED	DISLIKE EXTREMELY	DISLIKE VERY MUCH	DISLIKE MODERATELY	DISLIKE SLIGHTLY	NEITHER LIKE NOR DISLIKE	LIKE SLIGHTLY	LIKE MODERATELY	LIKE VERY MUCH	LIKE EXTREMELY
0	1	2	3	4	5	6	7	8	9
9. Coconut Bread				0 1 2 3 4	5	6	7	8	9
10. Tamale Bread Crisp				0 1 2 3 4	5	6	7	8	9
11. Bacon Cheese Bread				0 1 2 3 4	5	6	7	8	9
12. Orange Nut Bread				0 1 2 3 4	5	6	7	8	9
13. Blueberry Dessert				0 1 2 3 4	5	6	7	8	9
14. Apple Cinnamon Dessert				0 1 2 3 4	5	6	7	8	9
15. Choc. Halva Dessert				0 1 2 3 4	5	6	7	8	9
16. Choc. Chip Dessert				0 1 2 3 4	5	6	7	8	9
17. Pecan Dessert Bar				0 1 2 3 4	5	6	7	8	9
18. Graham Dessert				0 1 2 3 4	5	6	7	8	9
19. Almond Dairy Bar				0 1 2 3 4	5	6	7	8	9
20. Vanilla Dairy Bar				0 1 2 3 4	5	6	7	8	9
21. Mixed Nut Dairy Bar				0 1 2 3 4	5	6	7	8	9
22. Strawberry Dairy Bar				0 1 2 3 4	5	6	7	8	9
23. Orange Pine. Coco. Dairy Bar				0 1 2 3 4	5	6	7	8	9
24. Banana Dairy Bar				0 1 2 3 4	5	6	7	8	9
25. Shredded Wheat Bar				0 1 2 3 4	5	6	7	8	9
26. Bran Flake Bar				0 1 2 3 4	5	6	7	8	9
27. Malted Wheat Granules Cereal Bar				0 1 2 3 4	5	6	7	8	9
28. Wheat Flake Bar				0 1 2 3 4	5	6	7	8	9
29. Oat Cereal Biscuit Bar				0 1 2 3 4	5	6	7	8	9
30. Corn Flake Bar				0 1 2 3 4	5	6	7	8	9
31. Tropical Punch Beverage Bar				0 1 2 3 4	5	6	7	8	9
32. Orange Beverage Bar				0 1 2 3 4	5	6	7	8	9
33. Strawberry Beverage Bar				0 1 2 3 4	5	6	7	8	9
34. Lemonade Beverage Bar				0 1 2 3 4	5	6	7	8	9
35. Lemon-Lime Beverage Bar				0 1 2 3 4	5	6	7	8	9
36. Raspberry Beverage Bar				0 1 2 3 4	5	6	7	8	9
37. Cocoa Beverage Bar				0 1 2 3 4	5	6	7	8	9
38. Beef Jerky				0 1 2 3 4	5	6	7	8	9
39. Tea				0 1 2 3 4	5	6	7	8	9
40. Coffee				0 1 2 3 4	5	6	7	8	9
41. Chewing Gum				0 1 2 3 4	5	6	7	8	9

6. Please rate how much you like or dislike the RLW for breakfast, lunch, and dinner. Circle one number for each of the three meals.

NEVER TRIED	DISLIKE EXTREMELY	DISLIKE VERY MUCH	DISLIKE MODERATELY	DISLIKE SLIGHTLY	NEITHER LIKE NOR DISLIKE	LIKE SLIGHTLY	LIKE MODERATELY	LIKE VERY MUCH	LIKE EXTREMELY
0	1	2	3	4	5	6	7	8	9

a. For breakfast 0 1 2 3 4 5 6 7 8 9

b. For lunch 0 1 2 3 4 5 6 7 8 9

c. For dinner 0 1 2 3 4 5 6 7 8 9

7. When did you usually eat during the exercise? Circle one number.

1 - At specific meal times (imposed by command)

2 - At specific meal times (my choice)

3 - Throughout the day, as time permitted

4 - Both 1 and 3

5 - Both 2 and 3

8. Did you eat all of the RLW meal(s) you received a day? _____

9. When did you usually drink the following beverages? Check the appropriate line or lines for each beverage.

	DID NOT DRINK	WITH BREAKFAST	WITH LUNCH	WITH DINNER	BETWEEN MEALS
a. Lemonade Beverage	___	___	___	___	___
b. Lemon-Lime Beverage	___	___	___	___	___
c. Raspberry Beverage	___	___	___	___	___
d. Cocoa	___	___	___	___	___
e. Coffee	___	___	___	___	___
f. Tea	___	___	___	___	___
g. Orange Beverage	___	___	___	___	___
h. Strawberry Beverage	___	___	___	___	___
i. Tropical Punch Beverage	___	___	___	___	___
j. Water (no flavor)	___	___	___	___	___

PLEASE TURN OVER

10. Overall, did you get enough to eat or were you HUNGRY? Circle one number.

GOT ENOUGH	SOMETIMES HUNGRY	OFTEN HUNGRY	ALMOST ALWAYS HUNGRY
1	2	3	4

11. Overall, did you get enough to drink or were you THIRSTY? Circle one number.

GOT ENOUGH	SOMETIMES THIRSTY	OFTEN THIRSTY	ALMOST ALWAYS THIRSTY
1	2	3	4

12. On a typical day, did you eat alone or in a group? Circle one.

a. alone
b. with one person
c. with two people
d. with more than two people

13. On a typical day, did you drink alone or in a group? Circle one.

a. alone
b. with one person
c. with two people
d. with more than two people

14. Please rate how satisfied or dissatisfied you were with each of the following aspects of the RLW you ate. Circle one number for each aspect.

EXTREMELY DISSAT-ISFIED	VERY DISSAT-ISFIED	MODERA-TELY DIS-SATISFIED	SLIGHTLY DISSATIS-FIED	NEITHER SATISFIED NOR DISSAT-ISFIED	SLIGHTLY SATISFIED	MODERA-ATELY SATISFIED	VERY SAT-ISFIED	EXTREMELY SATISFIED
1	2	3	4	5	6	7	8	9

a. How easy the ration is to prepare 1 2 3 4 5 6 7 8 9

b. How easy the ration is to heat 1 2 3 4 5 6 7 8 9

c. How the food tastes 1 2 3 4 5 6 7 8 9

d. How the food looks 1 2 3 4 5 6 7 8 9

e. How much food there is in one day's meal pack 1 2 3 4 5 6 7 8 9

f. How much variety there is within one day's meal pack 1 2 3 4 5 6 7 8 9

g. How much variety there is from meal pack to meal pack 1 2 3 4 5 6 7 8 9

15. We would like to know what you think of the AMOUNT of food provided by each part of the RLW. Was the amount too small, too large or just right? Please circle one number for each part of the ration.

VERY MUCH TOO SMALL	MUCH TOO SMALL	MODERATELY TOO SMALL	SLIGHTLY TOO SMALL	JUST RIGHT	SLIGHTLY TOO LARGE	MODERATELY TOO LARGE	MUCH TOO LARGE	VERY MUCH TOO LARGE
1	2	3	4	5	6	7	8	9

a. Entree bars (chicken a la king, etc.)	1	2	3	4	5	6	7	8	9
b. Breakfast foods (cereal bars, etc.)	1	2	3	4	5	6	7	8	9
c. Desserts (blueberry, strawberry, etc.)	1	2	3	4	5	6	7	8	9
d. Beverages (cocoa, fruit drinks, etc.)	1	2	3	4	5	6	7	8	9
e. Candies	1	2	3	4	5	6	7	8	9
f. Beef Jerky	1	2	3	4	5	6	7	8	9

16. We would like to know your opinion or the amount of VARIETY in the RLW. Please circle number 1 if the amount of variety is sufficient. Circle one of the other numbers (2-6) to represent how much more variety should be increased.

VARIETY NOW ENOUGH	SLIGHTLY MORE VARIETY	SOMEWHAT MORE VARIETY	MODERATELY MORE VARIETY	MUCH MORE VARIETY	VERY MUCH MORE VARIETY
1	2	3	4	5	6

a. Entree bars (chicken, beef, etc.)	1	2	3	4	5	6
b. Breakfast foods (cereal bar, etc.)	1	2	3	4	5	6
c. Desserts (cookies, brownies, etc)	1	2	3	4	5	6
d. Beverages (cocoa, tea, Kool-Aid,etc.)	1	2	3	4	5	6
e. Fruit Soups (strawberry, raspberry, etc.)	1	2	3	4	5	6
f. Traditional Soups (chicken, beef, vegetable)	1	2	3	4	5	6
g. Candies	1	2	3	4	5	6

17. Do you think that any foods or beverages should be DROPPED from the RLW? Circle one: YES/NO. If yes, list the item(s)._____

_____

18. Do you think that any items should be ADDED to the RLW? Circle one: YES/NO. If yes, list the item(s). Be realistic!_____

PLEASE TURN OVER

19. For what reasons did you NOT eat enough during the exercise? Circle ALL the the reasons that apply to you. If you ALWAYS ate enough during this exercise, circle "a" only.

a. Always ate enough during this exercise.

b. Disliked the food in the ration.

c. Not enough food provided in the ration.

d. Not enough time to prepare ration.

e. Too much trouble to prepare ration.

f. Too cold to eat.

g. Not enough time to eat the ration.

h. No heat source to heat the ration.

i. Poor heat source to heat the ration.

j. Not enough water to prepare the ration.

k. Got bored with the food in the ration-not enough variety.

l. Other - please explain_____

20. If you circled more than one reason in the preceding question (#19), what was the MOST FREQUENT reason you did not eat enough? Please write the letter from the list above. ____

21. When were you able to get enough water to prepare foods and beverages? Circle one.

NEVER	ALMOST NEVER	SOMETIMES	FAIRLY OFTEN	OFTEN	ALMOST ALWAYS	ALWAYS
1	2	3	4	5	6	7

22. When were you able to get enough water to satisfy your thirst? Circle one.

NEVER	ALMOST NEVER	SOMETIMES	FAIRLY OFTEN	OFTEN	ALMOST ALWAYS	ALWAYS
1	2	3	4	5	6	7

23. How easy/difficult was it to obtain water? Circle one.

EXTREMELY EASY	VERY EASY	MODERATELY EASY	SLIGHTLY EASY	NEUTRAL	SLIGHTLY DIFFICULT	MODERATELY DIFFICULT	VERY DIFFI-CULT	EXTREMELY DIFFICULT
1	2	3	4	5	6	7	8	9

24. On the average, how many canteens (one canteen = 32 ounces = 1 quart) of water did you use each day for drinking, eating, and other uses such as washing? Write your best estimate using whole numbers and fractions, if necessary.

Drinking ____ canteens/day

Eating ____ canteens/day

Other ____ canteens/day

25. For what reason did you not drink enough during the exercise? Circle ALL the reasons that apply to you. If you ALWAYS drank enough during this exercise, circle "a" only.

a. Always drank enough during exercise.

b. Too much trouble to melt snow or ice.

c. Not enough time to melt snow or ice.

d. Stream water too far from site.

e. No equipment (pots, pans) to melt snow.

f. Not enough equipment to melt snow.

g. No heat source or stove.

h. Not enough heat sources or stoves for the group.

i. Water in canteen kept freezing.

j. Not enough beverages (cocoa, fruit flavored beverages, etc.) in MRE.

k. Other _____.

26. If you circled more than one reason in the preceding question (#25) what was the MOST FREQUENT reason you did not drink enough. Please write in the letter from the list above. ____

PLEASE TURN OVER

27. How did you obtain water? Circle all the ways you obtained water.

a. Melted snow
b. Melted ice
c. From an unfrozen stream
d. From an unfrozen lake or pond
e. 5 gallon cans
f. water buffalo
g. other _____

28. If you circled more than one way of obtaining water, which was the MOST FREQUENT? Please write in the letter from the list above: ____

29. How many times did you have to melt snow or ice to obtain water during the exercise? Please circle one.

NEVER	ONE TO THREE TIMES	FOUR TO NINE TIMES	ONCE EACH DAY	TWICE EACH DAY	THREE TIMES EACH DAY	FOUR TIMES EACH DAY	FIVE OR MORE TIMES EACH DAY
1	2	3	4	5	6	7	8

30. If you had to melt snow or ice did you work alone or in teams? Circle one.

a. alone
b. one other person
c. two other people
d. more than two other people

31. If you melted snow or ice, did you do it by choice or were you commanded to melt it? Circle one.

a. by choice b. by command c. both d. other _____

32. What was the typical temperature of the RLW foods and beverages that you consumed. Write the number that describes the typical temperature next to each food and beverage.

VERY COLD	COLD	COOL	NEUTRAL	WARM	HOT	VERY HOT
1	2	3	4	5	6	7

a. ___ entrees (chicken a la king, etc.)
b. ___ tea
c. ___ coffee
d. ___ fruit flavored beverages
e. ___ cocoa
f. ___ plain water

33. How often did the water in your canteen freeze during the exercise? Circle one number.

WATER NEVER FROZE	ONE TO THREE TIMES	FOUR TO NINE TIMES	ONCE EACH DAY	TWICE EACH DAY	THREE TIMES EACH DAY	FOUR TIMES EACH DAY	FIVE OR MORE TIMES EACH DAY	WATER ALWAYS FROZEN
1	2	3	4	5	6	7	8	9

34. How often did you use a beverage flavor (cocoa, beverage bar, tea, coffee) with your water. Circle one number.

NEVER	ALMOST NEVER	SOMETIMES	FAIRLY OFTEN	OFTEN	ALMOST ALWAYS	ALWAYS
1	2	3	4	5	6	7

35. Were the RLW preparation instructions helpful? Circle one.

NOT AT ALL HELPFUL	SLIGHTLY HELPFUL	SOMEWHAT HELPFUL	MODERATELY HELPFUL	VERY HELPFUL	EXTREMELY HELPFUL
1	2	3	4	5	6

36. Please rate how EASY or DIFFICULT you found each of the following aspects of preparing the RLW in the cold. Circle one number for each. (List continues on next page).

EXTREMELY EASY	VERY EASY	MODERATELY EASY	SLIGHTLY EASY	NEITHER EASY NOR DIFFICULT	SLIGHTLY DIFFICULT	MODERATELY DIFFICULT	VERY DIFFICULT	EXTREMELY DIFFICULT
1	2	3	4	5	6	7	8	9

a. Understanding preparation instructions	1	2	3	4	5	6	7	8	9
b. Opening the outer bags	1	2	3	4	5	6	7	8	9
c. Locating a specific item in the outer bag	1	2	3	4	5	6	7	8	9
d. Obtaining enough water to prepare foods or drinks	1	2	3	4	5	6	7	8	9

PLEASE TURN OVER

EXTREMELY EASY	VERY EASY	MODERATELY EASY	SLIGHTLY EASY	NEITHER EASY NOR DIFFICULT	SLIGHTLY DIFFICULT	MODERATELY DIFFICULT	VERY DIFFICULT	EXTREMELY DIFFICULT
1	2	3	4	5	6	7	8	9

e. Opening an individual packet 1 2 3 4 5 6 7 8 9

f. Heating water in order to prepare foods or drinks 1 2 3 4 5 6 7 8 9

g. Mixing the right amount of water with the dry ration items 1 2 3 4 5 6 7 8 9

h. Eating more than one item at a time 1 2 3 4 5 6 7 8 9

i. Keeping hands warm 1 2 3 4 5 6 7 8 9

j. Crumbling the ration before adding water 1 2 3 4 5 6 7 8 9

k. Avoiding spilling package contents 1 2 3 4 5 6 7 8 9

l. Sealing entree bag with plastic closure 1 2 3 4 5 6 7 8 9

37. Which did you usually wear on your hands while preparing and eating the RLW OUTSIDE? Circle ALL that apply.

a. Did not eat outside
b. Wool mitten insert with trigger finger
c. Wool glove insert
d. Black leather outer gloves
e. Arctic Mitten
f. Did not wear anything on my hands
g. Other _____

38. How did you heat the water to prepare the RLW items like entrees, desserts and cocoa? Circle all that apply.

a. Canteen cup stand and heating tabs
b. Zestotherm heat bags
c. Squad stove
d. Yukon stove
e. Mounted vehicle heater
f. Personal Stove (specify in detail) _____
g. Sterno
h. Did not heat rations
i. Other (specify) _____

39. If you heated your ration more than one way which way was the BEST? _____ (Write letter from previous question).

40. If you prepared and/or ate your RLW outside, how cold did your hands get. Circle one number below.

NOT AT ALL COLD	SLIGHTLY COLD	SOMEWHAT COLD	MODERATELY COLD	VERY COLD	EXTREMELY COLD
1	2	3	4	5	6

41. Overall, how long do you feel you could actually subsist on this ration? _____

42. Please give any other comments about the RLW below:

APPENDIX D

MANDATORY EQUIPMENT PACKING LIST

MANDATORY EQUIPMENT PACKING LIST (Minimum Each Person)

Rucksack

sleeping bag w/cover (+20 rated or -20 optional)
sleeping pad
2 pr wool socks
2 pr polypropylene socks
medium wt polypro top and bottom (ECWS)
heavy wt gore-tex suit (ECWS)
ski goggles
glacier glasses
climbing skins for skis
headlamp
seat harness
2 ea. Jumar ascenders
crampons
wool sweater or equivalent
snow shovel
ice ax
extra set of gloves or mittens
1 liter fuel bottle
2 ea liter water bottle
5 days Ration, Lightweight (RLW) w/carbohydrate supplement

Cross Loaded

5 ea Marmot Taku tents
5 ea Stoves (2 ea. MSR XG-K, 2 ea Coleman Peak II, 1 ea MSR Whisperlite)

Special Equipment

3 ea altimeters (one/rope team)
3 ea compass

2 ea avalanche transponders (lead and trail rope team)
3 ea Fischer Alpine Touring skis with Silvretta 400 bindings
1 ea Chinouard TUA Alpine Touring ski w/Emory binding
6 ea Ramer Mountaineering Ski system
8 pr Asolo AFS 101 extreme cold weather boot
1 pr Koflach Ultra Extreme boot
1 pr Dynafit Alpine Touring boot
1 ea Motorola transceiver w/spare battery

APPENDIX E

AFTER ACTION REPORT ON EQUIPMENT SUCCESSES AND FAILURES

AFTER ACTION REPORT ON EQUIPMENT SUCCESSES AND FAILURES

Issue: Two cold weather injuries resulted in part from Gore-Tex over-garment shortcomings

Discussion. Two soldiers were injured on the lower back, suffering soft tissue abrasion complicated by cold weather injury. According to Dr. (COL) Charles Andersen, Chief, Department of Surgery, Madigan Army Medical Center (MAMC) at Ft Lewis, WA, this type of injury is very unusual, and this case was the first occurrence on record at MAMC. The Gore-Tex trouser (NSN 84101-x01-0111) is a waist fastening trouser which is worn under the Gore-Tex jacket (NSN 84101-x01-0100). Worn while carrying a rucksack, the trouser was forced down the lower back by the pack's waist strap, exposing that area of skin to wind and cold air. The problem cannot be repaired in the field. Attempts to raise the trousers using suspenders were only moderately successful. One of the injured individuals had been wearing suspenders, with the trousers raised to the highest level possible above the waist. The other soldier hurt put suspenders on half-way through the ski march, but still had the same probiem.

Recommendation. Bib type trousers should be issued to special operations soldiers working in cold weather environments. There are several commercially available off-the-shelf models.

Conclusion. This problem has come to surface as a result of a training exercise involving a ski climb under heavy load. To the best of our knowledge, this was the first attempt at this type of an operation in the First Special Forces Group. The injuries are more preventable with the knowledge gained from this exercise, but equipment upgrades for this outer garment system are warranted.

Issue: Inadequate cold weather handwear system for SOF

Discussion. There is an equipment shortfall in the area of cold weather gloves. The current SFG issue includes a mitten shell with polypropylene mitten liner. (A polypropylene glove liner was issued but since discontinued). A handwear system that allows for intermittent "high touch" hand work is essential. Individuals participating in this exercise wore a variety of handwear items: the issue mitten system, Gates gloves, Korean "Gore-Tex" gloves, military leather shell with wool inserts, and the old style leather trigger finger mitten, with wool liner. The team experienced one case of frost bite, and three cases of frost nip, due primarily to the handwear items becoming wet during an evening movement and not fully drying overnight in an emergency bivouac.

Recommendation. An extreme cold weather handwear system be purchased or made. Helly Hansen manufactures a system currently used by the Norwegian Army, which meets most of our specification. 2nd Bn, 1 SFG, Equipment Board should pursue this issue.

Conclusion. Handwear is critical for any mission in a cold weather environment and the serious shortcomings of currently available handware should receive immediate attention.

Issue: Suitability of rigid, technical, cold weather boots for military skiing operations

Discussion. USARIEM was able to equip each exercise participant with a pair of the Asolo boots with two exceptions. One test subject chose to wear his personally owned Koflach Ultra-Extreme cold weather boot sytem and another, who wears size 13, was forced to rent a pair of Dynafit ski mountaineering boots. The Asolo boots were used with satisfactory results. There were some small problems with abrasion, due partly from the rigid design of the boot for ice climbing applications. There was one case of frostbite in the area of the toes, otherwise no other noted foot problems. The frostbite was due largely to the nature of the situation on which the soldier was

placed, and not a defect in the boot. It is believed that the boot prevented possible critical injury to the soldier's foot by maintaining a minimal level of insulation, even when immersed in snow or water. The boots matched the wire bale of the Ramer and Silvretta 400, ski binding, and crampons were easily mounted. The rigid sole lacks sufficient flexibility for extended foot travel, but is well suited to military skiing situations. The Dynafit boot caused some severe toe squeeze under a rucksack load, but was otherwise adequate. The Koflach boots have been for worn several years without any significant problem.

Recommendation. Study the possible acquisition of a rigid, technical, cold weather boot for military skiing applications. The 2nd Bn, 1 SFG, has a need for an intermediate cold weather boot that has the capability of being adapted to common types of ski bindings. The Asolo AFS 101, or the Koflach Ultra-Extremes are "off-the-self" products ready to fill the gap between Danners and Vapor Barrier boots.

Conclusion. Obtain authorization to purchase enough pairs to outfit two teams in each company for evaluation. This should give enough size range to cross equip other detachments for specific missions or training events.

Issue: Suitability of MSR XG-K multi-fuel stoves for cold weather military operations.

Discussion. The MSR XG-K stove worked exceptionally well during this exercise. Soldiers used it at 10,000 ft to melt snow and boil water. It performed efficiently, operating for 7 consecutive hours on a 22 fl. oz. fuel bottle of white gas, reconstituting 25 liters of water from snow during that period. It was not without tactical sacrifice, however. The stove must be primed by pumping fuel into a pre-heating bowl, located at the base of the burner head, and flashes a bright flame when ignited. The stove burns rather loudly as well. Subjects also had a Coleman Peak II, and a MSR Whisperlite. The XG-K was clearly superior to the Coleman and somewhat better than the Whisperlite which does not have a pre-heating tube running through the burner, as the XG-K does. The Whisperlite was the quietest of the three. The advantage of

the Coleman is its 12 ounce fuel reservoir attached to the stove, giving additional fuel carrying capacity (or at least a savings in bulk vs carrying additional fuel bottles).

Conclusion. Consideration must be given to the nature of the mission, the characteristic of the stove, and the availability of a fuel supply when choosing a stove.

Issue: Suitability of different types of mountaineering skis during military mountaineering exercise.

Discussion. Several models of skis and bindings were used with the Asolo AFS 101 boot: the Chounaird TUA ski with Emery binding (both made in France); the Fischer Alpine Touring ski with Silvretta 400 bindings; the Ramer mountaineering ski system, currently used by the 2nd Bn. The Chippewa black boot will work with each ski system, but does not satisfy insulation requirements in sub-freezing weather, as well as not providing ankle support for downhill skiing. The Emery binding is more like a conventional downhill binding than either the Ramer or Silvretta system. It has a step in heel binding as well as the common lateral release toe binding. It was slightly more difficult to step back into after a release, because of the heel lock down mechanism, but was stable during movement uphill or across flat terrain, as well as during downhill traversing using either telemark or nordic technique. The Silvretta system has been used in other exercises by the 2nd Bn, and is acknowledged as the binding of choice among the experienced combat skiers. The Chounaird ski performed exceptionally well, distributing the mission-loaded skiers weight evenly, and provided responsive maneuverability. The Fischer skis also performed well. The ball and socket bail system on the toe of the Ramer system resulted in numerous problems putting the binding back on after release. The system released prematurely on most occasions because of the age of the equipment on hand. The Ramer ski was generally too short to maneuver easily, and did not evenly distribute the skiers weight. The climbing skins used were the buckle type now stocked by Bn S-4. The skins should be taped across the ski at intervals along the length of the ski, especially at the tip and tail. This will prevent the skins from coming off the ski during movement. Thought should be given to using the skins during downhill traverse under load to allow more control of the ski.

Recommendation. The suitability of various mountaineering skis for military use should be considered by the Winter Warfare Equipment Board.

Conclusion. RAINIEREX provided ODA 155 the opportunity to experiment with several types of mountaineering ski configuration available on the commercial market. The Ramer ski system currently on hand is too old to consider for continued use and should be salvaged as soon as the interim ski set arrives.

APPENDIX F

RESPONSES TO RATION LIGHTWEIGHT (RLW) QUESTIONNAIRE ADMINISTERED POST-TEST TO 10 SUBJECTS

APPENDIX F, TABLE 1. Responses to Noncategory Scale, Multiple Choice and Other Questions

Question No./Item.	Responses
1. Time in Service	Mean: 12.1 years
2. Rank	E-6: 4; E-7: 4; CW2: 1; Cpt: 1
Age	Mean: 31.5 years; Range: 25-42
3. Previously in field with only operational rations?	Yes: 6; No: 4
a. Number of times (N=6)	10 to 40 times
b. Average length of exercise (N=8)	10 to 45 days
4. Description of weather during present exercise.	Somewhat Cold: 1 Moderately Cold: 6 Extremely Cold: 3
7. When subjects ate during the exercise.	Own choice of meal times: 1 During day,time permitting: 5 Combination of above: 4
8. Ate all of RLW meals received each day?	Yes: 0 No: 10

9. When beverages were consumed.

	Not at All	Break-fast	Lunch	Dinner	Between Meals
Lemonade	2	1	-	5	5
Lemon-Lime	4	1	-	1	5
Raspberry	3	1	-	1	6
Cocoa	2	2	-	3	5
Coffee	4	3	-	3	3
Tea	-	3	2	5	6
Orange	4	1	-	1	6
Strawberry	4	1	-	1	6
Tropical Punch	4	1	-	1	6
Water (Unflavored)	1	7	8	8	9

10. Enough to eat/were you hungry?	Got enough: 6 Sometimes hungry: 3 Often hungry: 1
11. Enough to drink/were you thirsty?	Got enough: 3 Sometimes thirsty: 5 Often thirsty: 2
12. Eat alone or in group?	Alone: 3 With one person: 4 More than two people: 3
13. Drink alone or in group?	Alone: 3 With one person: 4 Two people: 1 More than two people: 2

Appendix F, Table 1. Responses to Noncategory Scale Questions (Continued)

Question No./Item.	Responses
17. Items that should be dropped from RLW.	Yes: 4; No: 5 Items, from "Yes" answers: coconut & orange-nut bread crisps (4); tamale bread crisp (1); strawberry beverage & blueberry dessert bar (2).
18. Items that should be added to RLW.	Chicken soup, energy bars, non-meat entrees, chocolate bar additional accessory packet.
19 & 20. Reasons for not eating enough during enough during exercise (most frequent reason).	a. Always ate enough: 1 b. Dislike the food: 2 d. Not enough time to prepare: 5(1) e. Too much trouble to prepare: 2(1) f. Too cold to eat: 5(1) h. No heat source to heat: 1 i. Poor heat source to heat: 1 j. Not enough water to prepare: 5(1) k. Bored with food/not enough variety: 3(2)
21. Able to get enough water to prepare foods and beverages?	Almost never: 3; Sometimes: 1; Fairly often: 1; Often: 3; Almost always: 2
22. Able to get enough water to satisfy thirst?	Sometimes: 2; Fairly often: 1; Often: 2; Almost always: 3; Always: 2.
23. Ease/difficulty of obtaining water.	Very easy: 1; Moderately easy: 3; Neutral: 2; Slightly difficult: 2; Moderately difficult: 1
24. Number of canteens water used each day, all purposes.	Means. For drinking, 2.3; For food preparation: 0.7.
25. Reasons for not drinking enough water during exercise.	a. Always enough: 2; b. Too much trouble to melt snow/ice: 5 c. Not enough time to melt snow/ice: 4
26. Most frequent reason for not drinking enough water.	c. Too much trouble to melt snow/ice: 2
27. How water was obtained.	a. Melted snow: 10 b. Melted ice: 1 g. Other: 1. Ate snow on the move.
28. Of multiple ways of obtaining water, most frequent way used.	a. Melted snow: 1

Appendix F, Table 1. Responses to Noncategory Scale Questions (Continued)

Question No./Item.	Responses
29. Number of times during exercise that snow or ice had to be melted to obtain water.	1-3 Times: 3; 4-9 Times: 1; Twice/day: 2; 3 Times/day: 1; 4 Times/day; 1; 5 Times/day: 2
30. When melting snow or ice, work alone or in teams?	b. One other person: 1 c. Two other people: 5 d. More than two other people: 4
31. If melting snow or ice, do it by choice or commanded to do it?	a. By choice: 6 b. By command: 1 c. Both of above: 2 d. Other: 1; It was the only water source.
32. Typical temperatures of RLW foods and beverages consumed.	Means, 1=Very Cold to 7=Very Hot. a. Entrees: 5.1 b. Tea: 5.3 c. Coffee: 6.0 d. Fruit Flavored Beverages: 3.6 e. Cocoa: 4.7 f. Plain water: 2.2
33. Frequency of water freezing in canteen during exercise.	Never: 4 One to three times: 3 Once each day: 1
34. Frequency of adding a beverage powder to water.	Never: 2 Sometimes: 3 Fairly often: 1 Often: 2 Almost always: 1
35. Were RLW preparation instructions helpful?	Not at all helpful: 1 Slightly: 2 Somewhat: 2 Moderately: 5
37. What was worn on hands when preparing/eating RLW outside?	c. Wool glove insert: 3 e. Arctic mitten: 2 f. Nothing: 2 g. Other: 5. Gore-Tex gloves (3); polypropylene liners (2).
38. How water was heated to prepare foods and beverages.	f. Personal stove: 8. MSR Stove (6); Peak 1 Multifuel (1); Unspecified (1). No response: 2
39. Best way of heating rations (from previous question).	No responses.
40. How cold did hands get when preparing/eating RLW outside?	Slightly: 2; Somewhat: 3; Moderately: 2; Very: 2; Extremely: 1

Appendix F, Table 1. Responses to Noncategory Scale Questions (Continued)

NOTE: Nine responses were received to each of the following questions.

Question No./Item.	Responses
41. Design own daily ration from items available in RLW. How many packages of each type item for total of 8/day	Ranges: Entree bars: 1 or 2; Bread crisps: 0 or 1; Dairy bars: 0, 1 or 2; Fruit beverage bars: 0 or 1; Cocoa beverage bar: 0 or 1; Dessert bars: 0, 1 or 2; Cereal bars: 1 or 2; Beef jerky: 1, 2, 3 or 4.

42. Frequency of rehydrating dry ration components (bars).

	Never	< 1/2 Time	1/2 Time	> 1/2 Time	Always
Entree		2			6
Dairy	6	1			1
Fruit Beverage	3	1		4	1
Cereal	8	1			
Cocoa	2	2	2	2	

43. Reasons for not rehydrating dry components of ration.

a. Dehydrated foods tasted better dry. Foods: Cereal bars (2); Dairy bars (2).
b. Dehydrated foods had better texture. Cereal bars (1); Dairy bars (1).
c. Not enough water available: 5
d. Too much trouble to mix: 5
Other (verbatim): Foods ok either way; fruit beverage bars would not rehydrated w/ cold water unless first crushed into powder.

44. Rank order of combat ration attributes for cold weather mission.

	Mean Rank	Numeric Rank
Light weight	1.8	1
Takes up little space	2.9	3
Tastes good	3.5	5
Stops my hunger	3.1	4
Give me enough energy	2.1	2

45. Rating of ration for same attributes.

Scale: Excellent=1 to Poor=4

	Mean
Light weight	1.7
Takes up little space	1.6
Tastes good	2.8
Stops my hunger	2.4
Give me enough energy	2.2

46. How long subjects felt they could subsist on ration.

Range: 14 to 45 days; Other comments: As long as necessary; any operational duration.

APPENDIX TABLE 2. Responses To Category Rating Scale Questions, Mt.Rainier, WA Cold Weather Exercise

Question 5. Nine-Category Hedonic Scale Ratings For RLW Components. (1=Dislike extremely; 5=Neither Like nor Dislike; 9=Like Extremely)

Food Group/Item	No. of Ratings	No.Never Tried	Mean ± SD
Entrees			
Beef stew	7	3	6.8 ± 1.2
Chicken ala King	6	4	6.3 ± 1.8
Chicken w/Rice and Ham	8	2	7.3 ± 0.9
Chili con Carne	8	2	7.3 ± 0.9
Spaghetti w/Meat Sauce	8	2	6.0 ± 2.5
Bread Crisps			
Bacon	7	3	5.1 ± 2.0
Coconut	7	3	2.7 ± 2.3
Nacho Cheese	4	6	5.5 ± 0.6
Orange Nut	6	4	2.0 ± 2.0
Pizza	8	2	5.8 ± 1.5
Tamale	4	6	5 8 ± 2.1
Dessert Bars			
Apple	7	3	8.0 ± 0.8
Blueberry	6	4	7.5 ± 1.4
Chocolate Chip	6	4	7.9 ± 0.8
Chocolate Halva	8	2	7.5 ± 1.0
Graham	6	4	6.7 ± 0.5
Pecan	5	5	6.6 ± 2.1
Dairy Bars			
Almond	5	5	6.5 ± 1.4
Banana	6	4	6.3 ± 1.2
Mixed Nut	4	6	5.8 ± 1.4
Orange-Pineapple-Coconut	3	7	4.8 ± 1.8
Strawberry	6	4	5.6 ± 1.6
Vanilla	6	4	6.6 ± 1.4
Cereal Bars			
Bran Flake	9	1	6.6 ± 1.4
Corn Flake	7	3	7.0 ± 0.8
Malted Wheat	7	3	6.4 ± 1.6
Oat Cereal	5	5	7.0 ± 0.7
Shredded Wheat	7	3	7.3 ± 1.0
Wheat Flake	6	4	7.0 ± 0.6
Beverage Bars			
Cocoa	8	2	6.7 ± 1.7
Lemon-Lime	7	3	6.4 ± 2.5
Lemonade	8	2	6.1 ± 2.3
Orange	6	4	6.7 ± 1.2
Raspberry	5	5	6.8 ± 2.2
Strawberry	6	4	6.4 ± 2.6
Tropical Punch	4	6	7.5 ± 0.6
Accessory Items			
Beef Jerky	10	0	8.4 ± 0.8
Chewing Gum	8	2	8.3 ± 1.2
Coffee	5	5	7.6 ± 1.3
Tea	10	0	8.8 ± 0.4

APPENDIX TABLE 2. Posttest Responses To Rating Scale Questions, Mt. Rainier, WA Cold Weather Exercise (Continued).

Question 6. Overall RLW Ratings, 9-Category Hedonic Scale.

Meal	No. of Ratings	No. Never Tried	Mean ± SD
Breakfast	8	2	5.0 ± 2.1
Lunch	9	1	6.1 ± 1.4
Dinner	9	1	6.7 ± 1.9

Question 14. Satisfaction-Dissatisfaction Ratings For Seven RLW Ration Attributes, 9-Category Scale (1=Extremely Dissatisfied, 5= Neither Satisfied Nor Dissatisfied, 9=Extremely Satisfied)

Attribute	Mean ± SD (N =10)
a. How easy the ration is to prepare	6.8 ± 1.6
b. How easy the ration is to heat	6.6 ± 1.3
c. How the food tastes	6.3 ± 1.5
d. How the food looks	5.6 ± 1.9
e. How much food there is in one day's meal pack	6.2 ± 2.0
f. How much variety there is within one day's meal pack	6.4 ± 1.1
g. How much variety there is from meal pack to meal pack	6.1 ± 1.1

Question 15. Amount of Food Provided by Five Food Groups of the RLW Ration, 9-Category Scale (1=Very Much Too Small; 5=Just Right; 9=Very Much Too Large).

Food Group	No. of Ratings	No Response	Mean ± SD
Entree Bars	9	1	3.4 ± 1.8
Breakfast Foods	9	1	4.2 ± 1.2
Desserts	9	1	4.7 ± 0.7
Beverages	10	0	5.4 ± 2.0
Beef Jerky	10	0	4.2 ± 1.3

APPENDIX TABLE 2. Posttest Responses To Rating Scale Questions, Mt. Rainier, WA Cold Weather Exercise (Continued).

Question 36. Ratings for RLW Preparation Steps, 9-Category Scale (1= Extremely Easy, 5=Neither Easy Nor Difficult, 9=Extremely Difficult)

Preparation Step	No. of Ratings	No response	Mean ± SD
a. Understanding preparation. instructions	10	0	1.7 ± 0.8
b. Opening the outer bags	10	0	3.5 ± 2.1
c. Locating a specific item in the outer bag	10	0	3.6 ± 2.3
d. Obtaining enough water to prepare foods or drinks	10	0	5.4 ± 2.2
e. Opening an individual packet	10	0	3.3 ± 1.9
f. Heating water to prepare foods/drinks	10	0	5.5 ± 1.8
g. Mixing the right amount of water with the dry ration items	10	0	3.9 ± 1.4
h. Eating more than one item at a time	10	0	5.3 ± 2.5
i. Keeping hands warm	10	0	6.0 ± 1.5
j. Crumbling the ration before adding water	10	0	5.5 ± 2.8
k. Avoiding spilling package contents	10	0	5.2 ± 2.3
l. Sealing entree bag with plastic closure	7	3	3.9 ± 2.3

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